Assembly, Installation, Setup

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Digital servo amplifier

SERVOSTAR® 640/670

KOLLMORGEN
Seidel

Previous versions :

Edition	Remarks
07/99	First edition
11/99	technical data, encoder connection diagram
12/99	encoder cable length
10/00	Dimensions mains filter, setup software on CD-ROM only, wiring diagrams electr. gearing, warning and error messages, recommended torque, various corrections
05/01	some UL/cUL related hints
01/02	-Options -I/O-14/08- and -2CAN - incorporated, hardware-description incorporated for PROFIBUS and SERCOS, nameplate, motor list and connector assignment corrected, LED-display corrected, error messages expanded, Regen resistor BAR replaced by BAS type
06/02	Front page new design, corrections to US english, motor table removed, order numbers added, last page new design and contents, new: connection to diff. mains supply networks, block diagram to ch.III

Manufactured under one or more of the following US patents:

4,434,389	4,447,771	4,456,934	4,463,299	4,479,078
4,490,661	4,504,755	4,508,988	4,532,461	4,538,080
4,541,575	4,543,520	4,551,646	4,559,485	4,562,399
4,572,999	4,579,012	4,633,151	4,644,199	4,647,824
4,661,756	4,670,696	4,675,547	4,679,313	4,682,093
4,686,437	4,698,537	4,729,160	4,763,049	4,763,056
4,763,057	4,733,149	4,782,272	4,797,592	4,857,816
4,868,475	4,868,970	4,912,381	4,926,063	4,935,080
4,943,760	4,954,739	4,992,716	5,051,634	5,144,183
5,173,651	5,194,786	5,399,908	5,435,517	5,530,396
5,574,636	5,606,791	5,625,265	5,633,793	5,646,467
5,715,590	5,736,916	5,739,648	5,754,732	5,789,841
5,829,118	5,912,638	5,949,202	5,949,359	5,998,905
6,002,234				

Technical changes which improve the performance of the equipment may be made without prior notice !

Printed in the Federal Republic of Germany

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Safety Instructions

- Only properly qualified personnel are permitted to perform activities such as transport, installation, setup and maintenance. Properly qualified persons are those who are familiar with the transport, assembly, installation, setup and operation of the product, and who have the appropriate qualifications for their job. The qualified personnel must know and observe:
  IEC 364 and CENELEC HD 384 or DIN VDE 0100
  IEC-Report 664 or DIN VDE 0110
  national accident prevention regulations or BGV A2

- Read this documentation before carrying out installation and setup. Incorrect handling of the servo amplifier can lead to personal injury or material damage. It is vital that you keep to the technical data and information on connection requirements (on the nameplate and in the documentation).

- The manufacturer of the machine must generate a hazard analysis for the machine, and take appropriate measures to ensure that unforeseen movements cannot cause injury or damage to any person or property.

- The servo amplifiers contain electrostatically sensitive components which may be damaged by incorrect handling. Ground yourself before touching the servo amplifier by touching any unpainted metal surface. Avoid contact with highly insulating materials (artificial fabrics, plastic film etc.). Place the servo amplifier on a conductive surface.

- Do not open the units. Keep all covers and switchgear cabinet doors closed during operation. Otherwise there are deadly hazards, with the possibility of severe danger to health or material damage.

- During operation, servo amplifiers, according to their degree of enclosure protection, may have uncovered live components. Control and power connections may be live, even if the motor is not rotating.

- Servo amplifiers may have hot surfaces during operation.

- Never undo the electrical connections to the servo amplifier while it is live. There is a danger of electric arcing with damage to contacts and danger to persons.

- Wait at least five minutes after disconnecting the servo amplifier from the mains supply voltage before touching live sections of the equipment (e.g. contacts) or undoing connections. Capacitors can still have dangerous voltages present up to five minutes after switching off the supply voltages. To be sure, measure the voltage in the DC-link circuit and wait until it has fallen below 40V.

European directives and standards

Servo amplifiers are components which are intended to be incorporated into electrical plant and machines for industrial use.
When the servo amplifiers are built into machines or plant, the intended operation of the amplifier is forbidden until it has been established that the machine or plant fulfills the requirements of the EC Directive on Machines 98/37/EC and the EC Directive on EMC (89/336/EEC). EN 60204 and EN 292 must also be observed.

The manufacturer of the machine must generate a hazard analysis for the machine, and take appropriate measures to ensure that unforeseen movements cannot cause injury or damage to any person or property.

In connection with the Low Voltage Directive 73/23/EEC , the harmonized standards of the EN 50178 series are applied to the amplifiers, together with EN 60439-1, EN 60146 and EN 60204.
The manufacturer of the machine or plant is responsible for ensuring that they meet the limits which are required by the EMC regulations. Advice on the correct installation for EMC - such as shielding, grounding, arrangement of filters, treatment of connectors and the laying out of cabling - can be found in this documentation.

CE - conformance

Conformance with the EC Directive on EMC 89/336/EEC and the Low Voltage Directive 73/23/EEC is mandatory for the supply of servo amplifiers within the European Community.
The servo amplifiers of the SERVOSTAR 640/670 series have been tested by an authorized testing laboratory in a defined configuration with the system components which are described in this documentation. Any divergence from the configuration and installation described in this documentation means that you will be responsible for the performance of new measurements to ensure that the regulatory requirements are met.

UL and cUL- Conformance

UL (cUL)-certified servo amplifiers (Underwriters Laboratories Inc.) fulfil the relevant U.S. and Canadian standard (in this case UL 840 and UL 508C).
This standard describes the fulfilment by design of minimum requirements for electrically operated power conversion equipment, such as frequency converters and servo amplifiers, which is intended to eliminate the risk of fire, electric shock, or injury to persons, being caused by such equipment. The technical conformance with the U.S. and Canadian standard is determined by an independent UL (cUL) inspector through the type testing and regular check-ups.
Apart from the notes on installation and safety in the documentation, the customer does not have to observe any other points in direct connection with the UL (cUL)-certification of the equipment.

UL 508C

UL 508C describes the fulfilment by design of minimum requirements for electrically operated power conversion equipment, such as frequency converters and servo amplifiers, which is intended to eliminate the risk of fire being caused by such equipment.

UL 840

UL 840 describes the fulfilment by design of air and insulation creepage spacings for electrical equipment and printed circuit boards.

Abbreviations used in this manual

The abbreviations used in this manual are explained in the table below.

Abbrev.	Meaning
AGND	Analog ground
AS	Restart Lock, option
BTB/RTO	Ready to operate
CAN	Fieldbus (CANopen)
CE	Communité Européenne (EC)
CLK	Clock signal
COM	Serial interface for a PC-AT
DGND	Digital ground
DIN	German Institute for industrial Standards
Disk	Magnetic storage (diskette, hard disk)
EEPROM	Electrically erasable programmable memory
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
EN	European standard
ESD	Electrostatic discharge
IEC	International Electrotechnical Commission
IGBT	Insulated Gate Bipolar Transistor
INC	Incremental Interface
ISO	International Standardization Organization
LED	Light-emitting diode
MB	Megabyte
MS-DOS	Operating system for PC-AT

Abbrev	Meaning
NI	Zero pulse
NSTOP	Limit-switch input for CCW rotation (left)
PC-AT	Personal computer with 80x86 Processor
PELV	Protected low voltage
PGND	Ground for the interface
PSTOP	Limit-switch input for CW rotation (right)
PWM	Pulse-width modulation
RAM	Volatile memory
Rregen	Regen resistor
RBext	External regen resistor
RBint	Internal regen resistor
RES	Resolver
ROD 426 (EEO)	A quad B encoder
PLC	Programmable logic controller
SRAM	Static RAM
SSI	Synchronous serial interface
SW/SETP.	setpoint
UL	Underwriters Laboratory
VAC	AC voltage
VDC	DC voltage
VDE	Verein deutscher Elektrotechniker
XGND	Ground for the 24V supply

Symbols used in this manual

	danger to personnel from electricity and its effects			general warning general instructions mechanical hazard
⇨	see page (cross-ref.)		●	special emphasis

Keys on the servo amplifier panel :	
▲	**press once** : move up one menu item, increase number by one **press twice in rapid succession** : increase number by ten
▼	**press once** : move down one menu item, decrease number by one **press twice in rapid succession** : decrease number by ten
▲ ▼	**hold right key pressed, and then press left key as well** : to enter number, “Return” function

I General

I.1 About this manual

This manual describes the digital servo amplifiers of the SERVO**STAR**® 640/670 series (standard version). You can find information about:

● Technical data of the servo amplifiers	Chapter I
● Assembly / installation	Chapter II
● Interfaces	Chapter III
● Setup the servo amplifier	Chapter IV
● Accessories	Chapter V
● Transport, storage, maintenance, disposal of the servo amplifiers	Chapter VI

A more detailed description of the expansion cards which are currently available and the digital connection to automation systems can be found on the accompanying CD-ROM in Acrobat-Reader format (system requirements: WINDOWS 95 with Internet browser) in English, German and French versions.
You can print this documentation on any standard printer. A printed copy of the documentation is available from us at extra cost.

This manual makes the following demands on qualified personnel :

Transport : ***only by personnel with knowledge in handling electrostatically sensitive components.***

Installation : ***only by electrically qualified personnel***

Setup : ***only by personnel with extensive knowledge of electrical engineering / drive technology***

I.2 Prescribed use (Use as directed) of the servo amplifier

The servo amplifiers are components which are built into electrical equipment or machines, and can only be used as integral components of such equipment. The manufacturer of the machine must generate a hazard analysis for the machine, and take appropriate measures to ensure that unforeseen movements cannot cause injury or damage to any person or property.

The SERVOSTAR 640/670 family of servo amplifiers can be connected directly to symmetrically earthed(grounded) three-phase industrial mains supply networks [TN-system, TT-system with earthed(grounded) neutral point, not more than 5000rms symmetrical amperes, 480VAC maximum] when protected by fuses type Fusetron FRS-R-50 forSERVOSTAR 640 or FRS-R-80 class RK5 for SERVOSTAR 670, manufactured by Bussman, or equivalent, 480VAC min.
The servo amplifiers must not be operated directly on power supply networks >230V without an earth (ground) or with an asymmetrical earth (ground).
Connection to other mains supply networks ⇨ p. 14.

The use of external mains chokes and mains filters is required.

Periodic overvoltages between outer conductor (L1, L2, L3) and housing of the servo amplifier may not exceed 1000V (peak value).
Transient overvoltages (< 50µs) between the outer conductors may not exceed 1000V.
Transient overvoltages (< 50µs) between outer conductors and housing may not exceed 2000V.

The regen resistors have to be protected by fuses type Limitron KLM, rated for 500VAC/DC

The SERVOSTAR 640/670 family of servo amplifiers is **only** intended to drive specific brushless synchronous servomotors with closed-loop control of torque, speed and/or position. The rated voltage of the motors must be at least as high as the DC-link voltage of the servo amplifier. The motor must have integral thermal protection.

The servo amplifiers **may only** be operated in a closed switchgear cabinet, taking into account the ambient conditions defined on page 17 and the dimensions shown on page 28. Ventilation or cooling may be necessary to prevent enclosure ambient from exceeding 45°C (113°F).

Use copper wire only. Wire size may be determined from EN 60204 (or table 310-16 of the NEC 60°C or 75°C column for AWG size).

We only guarantee the conformance of the servo amplifiers with the standards for industrial areas (page 7), if the components (motors, cables, amplifiers etc) are delivered by Seidel.

Restart lock -AS-

The restart lock -AS- is **exclusively** intended to provide safety for personnel, by preventing the restart of a system. To achieve this personnel safety, the wiring of the safety circuits must meet the safety requirements of EN60204, EN292 and VDI 2853.

The -AS- restart lock must **only** be activated,

— when the motor is no longer rotating (setpoint = 0V, speed = 0rpm, enable = 0V). Drives with a suspended load must have an additional safe mechanical blocking (e.g. by a motor-holding brake).

— when the monitoring contacts (KSO1/2 and BTB/RTO) for all servo amplifiers are wired into the control signal loop (to recognize a cable break).

The -AS- restart lock may **only** be controlled by a CNC if the control of the internal safety relay is arranged for redundant monitoring.

The -AS- restart lock must **not** be used if the drive is to be made inactive for the following reasons :

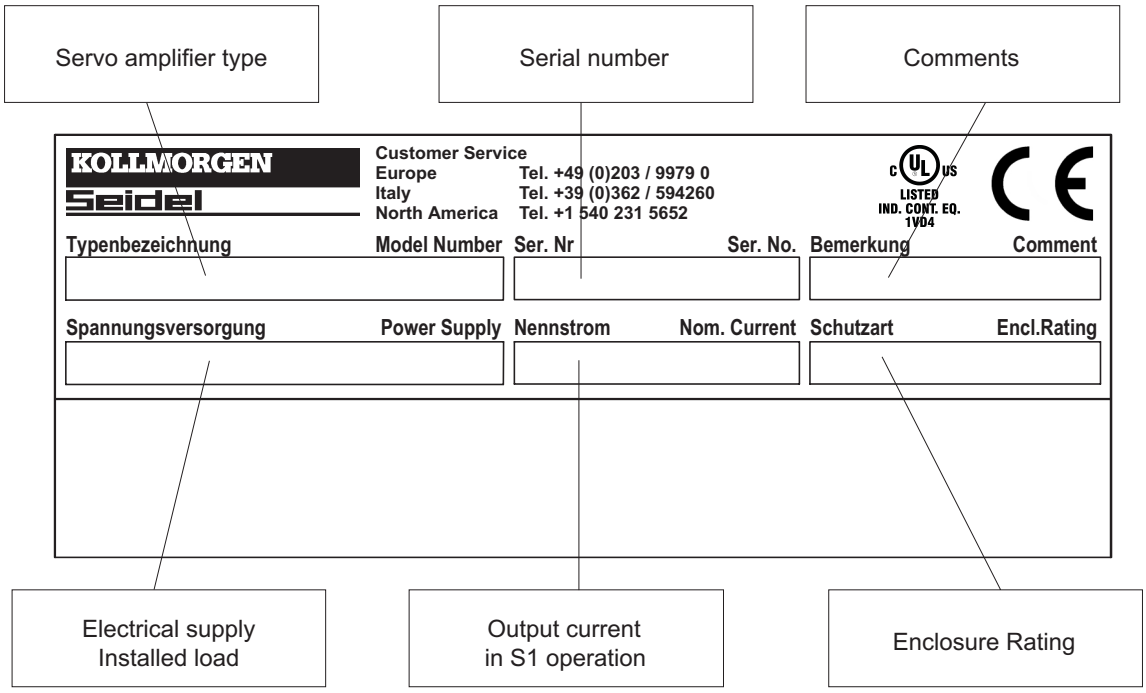
1. - cleaning, maintenance and repair operations
   - long inoperative periods

   In such cases, the entire system should be disconnected from the supply by the personnel, and secured (main switch).
2. - emergency-stop situations

   In an emergency-stop situation, the main contactor is switched off (by the emergency-stop button or the BTB-contact in the safety circuit).

I.3 Nameplate

The nameplate depicted below is attached to the side of the servo amplifier.
The information described below is printed in the individual fields.



I.4 Instrument description

I.4.1 Package supplied

When you order a SERVOSTAR 640/670 series amplifier, you will receive:

— SERVOSTAR 6xx
— mating connectors X3, X4

The mating SubD connectors are not part of the package!

— Assembly and Installation Instructions
— Online documentation on CD-ROM
— Setup software DRIVE.EXE on CD-ROM

Accessories: (must be ordered separately)

— Mains filter 3EF-xx (⇨ p.78) **required**
— Mains choke 3Lxx-yy (⇨ p.79) **required**
— AC Servomotor (linear or rotary)
— motor cable as a cut-off length
— brake cable as a cut-off length
— feedback cable (pre-assembled, see application note “Cables and connectors”) or both feedback connectors separately, with feedback cable as length
— external regen resistor (⇨ p.77)
— communications cable to the PC(⇨ p.54) or Y-adapter (⇨ p.59) for parameter setting of up to 4 or 6 servo amplifiers from one PC
— power cable, control cables, fieldbus cables (as lengths)

I.4.2 The digital servo amplifiers of the series SERVOSTAR 640/670

Standard version

- 2 current ratings (40 A, 70 A)
- wide range of rated voltage (3x208V $_{-10\%}$ to 3x480V $^{+10\%}$)
- shield connection directly at the servo amplifier
- two analog setpoint inputs
- integrated CANopen (default 500 kBaud), for integration into CANbus systems and for setting parameters for several amplifiers via the PC-interface of one amplifier
- integrated RS232, electrically isolated, integrated pulse-direction interface
- -AS- built-in safety relay (personnel-safety starting lock-out), (⇨ p.22)

Open architecture

- open hardware and software architecture
- slot for an expansion card
- integrated macro language, including compiler
- prepared for all conceivable customer-specific extensions

Options

- -I/O-14/08- expansion card, ⇨ p. 65
- PROFIBUS DP expansion card, ⇨ p. 69
- SERCOS expansion card, ⇨ p. 71
- -2CAN- Expansion module, separated connectors for CAN bus and RS232, ⇨ p. 73
- Third party expansion cards (ModBus, FireWire, LightBus etc. - contact distributors for further information)

I.4.3 Operation directly from supply

Electrical supply

- Directly off grounded 3~ system,
  230V$_{-10\%}$ ... 480V$^{+10\%}$, 50 Hz,
  208V$_{-10\%}$ ... 480V$^{+10\%}$, 60 Hz,

  TN-system, TT-system with earthed (grounded) neutral point, not more than 5000 rms symmetrical amperes, 480VAC maximum; when protected by fuses type Fusetron FRS-R-80 (Class RK5), manufactured by Bussman, or equivalent 480VAC min
  Connection to other mains supply networks only with insulating transformer ⇨ p. 14
- Fusing (e.g. fusible cutout) provided by the user

Auxiliary supply voltage 24VDC

- Electrically isolated, internal fusing (4 AT), from an external 24VDC psu, e.g. with insulating transformer

Power input filter

- **External interference suppression filter for the supply input (to Class A) required**
- Interference suppression filter for the 24V aux. supply (to Class A) is integrated

Mains choke

- **External mains choke required**

I.4.4 Digital servo amplifier concept

Operation and parameter setting

- With our user-friendly software for setup through the serial interface of a PC
- Direct operation by means of two keys on the servo amplifier and a 3-character LED display for status display in case of no PC available
- Fully programmable via RS232 interface

Power section

- Power supply: B6 rectifier bridge, off 3-phase earthed (grounded) supply, integral inrush circuit
- All shielding connections directly on the amplifier
- Output stage: IGBT- module with isolated current measurement
- Regen circuit: with dynamic distribution of the regen power between several amplifiers on the same DC-link circuit, external regen resistor
- DC-link voltage 260 — 900 VDC, can be switched in parallel

Completely digital control

- Digital current controller (space vector pulse-width modulation, 62.5 µs)
- Freely programmable digital speed controller (62.5 µs or 250 µs)
- Integral position controller with adaptation possibilities for customer needs (250 µs)
- Pulse direction interface integrated for connection of a servomotor to a stepping motor control
- Evaluation of the resolver signals and sine-cosine signals of a high-resolution encoder
- Encoder simulation (incremental or SSI)

Comfort functions

- Adjustable setpoint ramps
- 2 analog monitor outputs
- 4 programmable digital inputs (normally, two are defined as limit-switch inputs)
- 2 programmable digital outputs
- Freely programmable combinations of all digital signals

Integrated safety

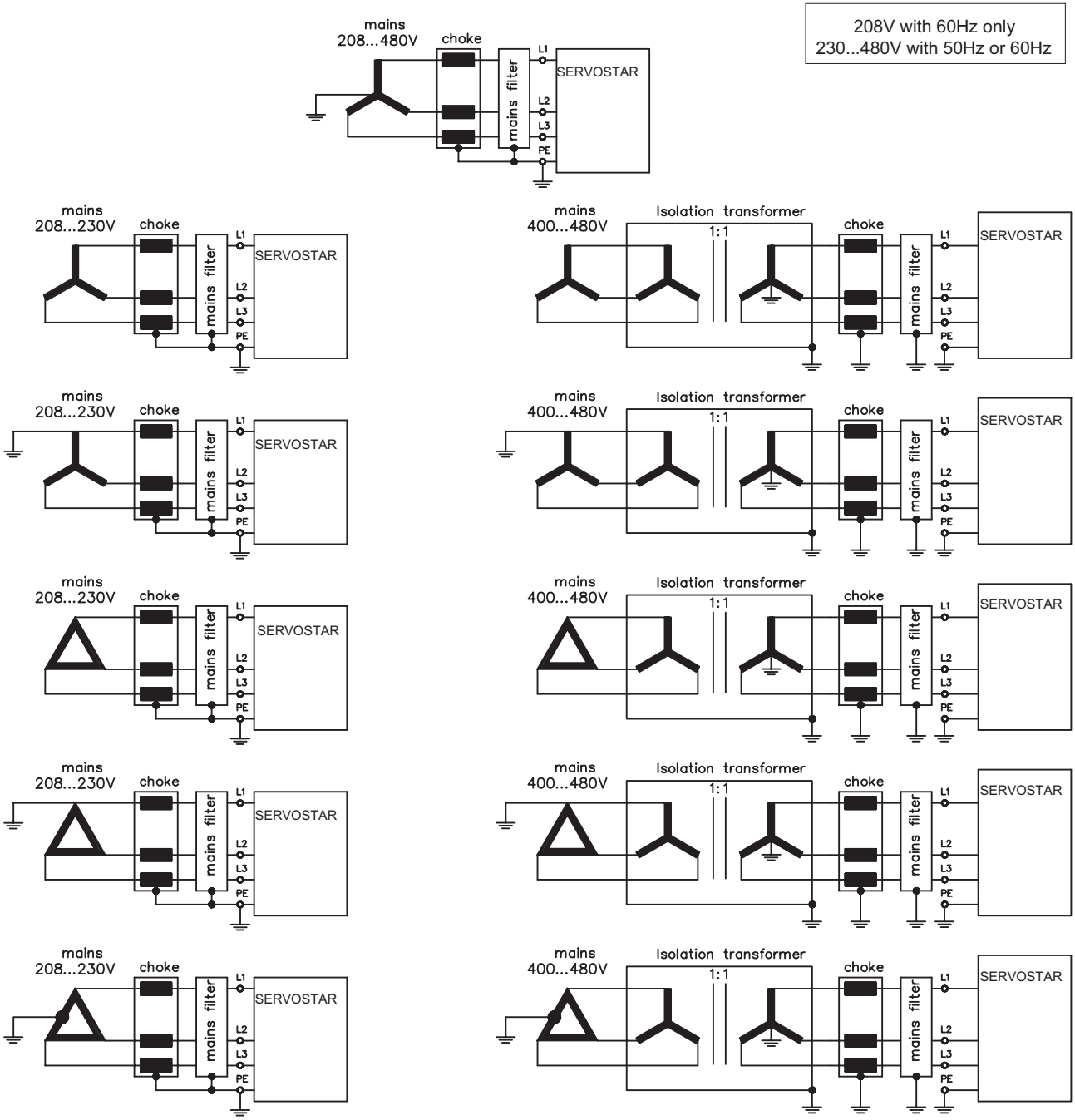
- Safe electrical separation to EN 50178 between the power input / motor connections and the signal electronics, provided by appropriate insulation/creepage distances and complete electrical isolation
- Soft-start, overvoltage recognition, short-circuit protection, phase-failure monitoring
- Temperature monitoring of servo amplifier and motor
(when using our motors with our pre-assembled cables)

I.5 Connection to different mains supply networks

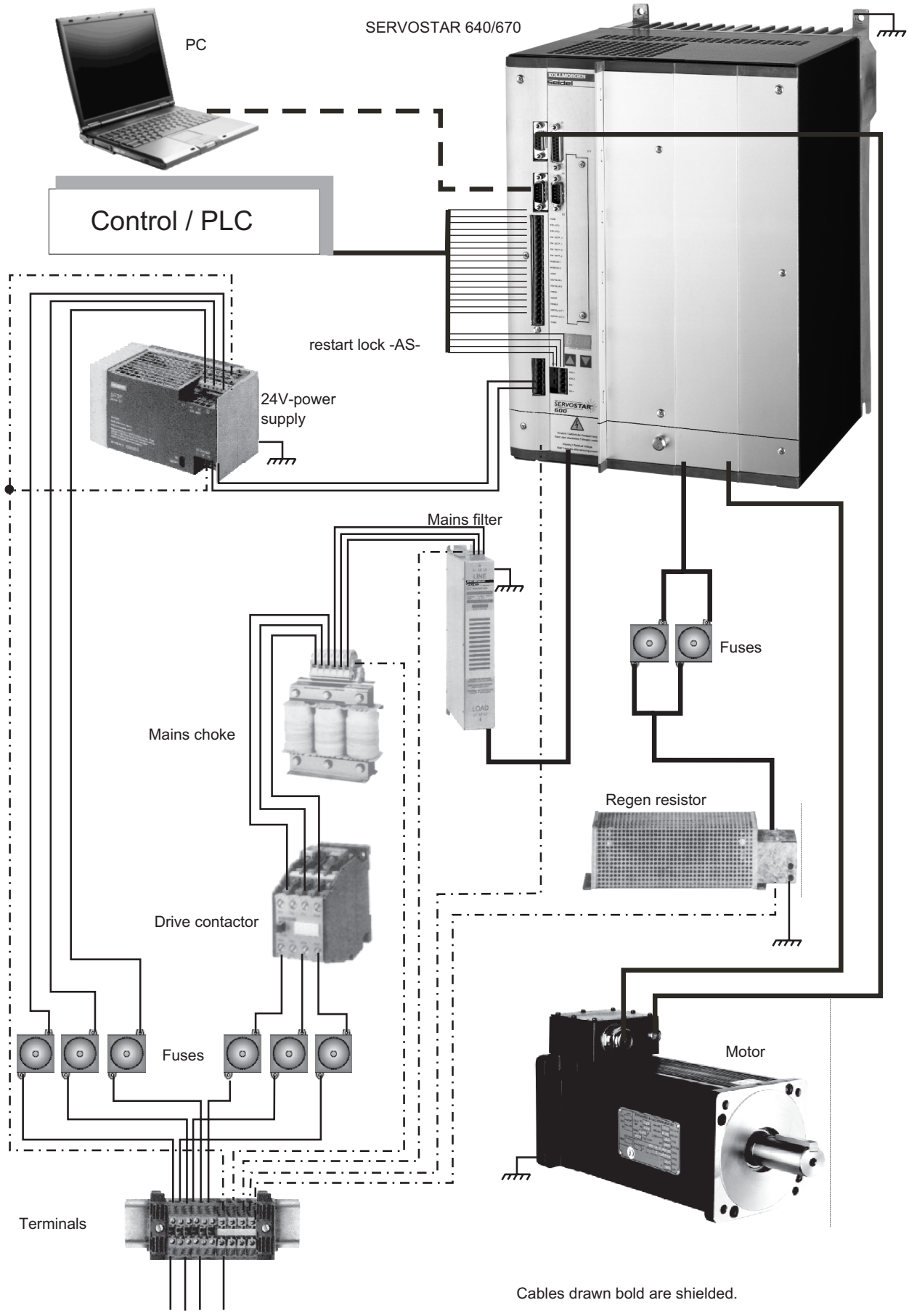
On this page you'll find all possible connection variations to different mains supply networks.

An isolating transformer is always required for 400...480V mains networks without earth(ground) and for networks with asymmetrical earth(ground).

208V with 60Hz only
230...480V with 50Hz or 60Hz



I.6 Components of a servo system



Cables drawn bold are shielded.

I.7 Technical data of the SERVOSTAR 640/670

Rated data	DIM	SERVOSTAR 640	SERVOSTAR 670		
Rated-supply voltage (grounded system)	V~	3 x 230V-10% ... 480V+10%, 50 Hz			
	V~	3 x 208V-10% ... 480V+10%, 60 Hz			
Rated installed load for S1 operation	kVA	30	50		
Rated DC-link voltage	V=	260 - 675			
Supply voltage range for output current	V~	230 ... 480	230	400	480
Rated output current (rms value, ± 3%)	Arms	40	85	80	70
Peak output current (max. ca. 5s, ± 3%)	Arms	80	160	160	140
Clock frequency of the output stage	kHz	8			
Technical data for regen circuit	—	⇨ p.19			
Overvoltage protection threshold	V	450...900			
Form factor of the output current (at rated data and min. load inductance)	—	1.01			
Bandwidth of subordinate current controller	kHz	> 1,2			
Residual voltage drop at rated current	V	5			
Quiescent dissipation, output stage disabled	W	40			
Dissipation at rated current (incl. power supply losses, without regen dissipation)	W	400	700		
Internal fusing (external fusing ⇨ p.16)					
Auxiliary supply 24V	—	internal 4 AT			
Regen resistor	—	internal, electronic			
Inputs					
Setpoint ½, resolution 14bit/12bit	V	±10			
Common-mode voltage max.	V	±10			
Input resistance to AGND	kΩ	20			
Digital inputs	V	low 0...7 / high 12...36			
	mA	7			
Digital outputs, open collector	V	max. 30			
	mA	10			
BTB/RTO output, relay contacts	V	DC max. 30, AC max. 42			
	mA	500			
Aux. power supply, electrically isolated	V	24 (-0% +15%)			
without brake	A	2			
Aux. power supply, electrically isolated	V	24 (-0% +15%)			
with brake (consider voltage loss!)	A	4			
Max. output current, brake	A	2			
Connections					
Control signals	—	Combicon 5,08 / 18 pole , 2,5mm²			
Power signals	—	Terminals 10mm² — 50mm²			
Resolver input	—	SubD 9pole (socket)			
Sine-cosine encoder input	—	SubD 15pole (socket)			
PC-interface, CAN	—	SubD 9pole (plug)			
Encoder simulation, ROD (EEO) / SSI	—	SubD 9pole (plug)			
Thermal control, Motor	—	min. 15VDC, 5mA			
Mechanical					
Weight	kg	19,5	21		
Height without shield sheet, w/o eyes (w. eyes)	mm	345 (375)			
Height with shield sheet, w/o eyes (w. eyes)	mm	484 (495)			
Width	mm	250			
Depth without connectors	mm	300			
Depth with connectors	mm	325			

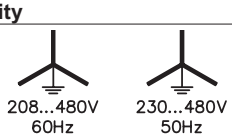
I.7.1 External fusing

Fusible cutouts or similar (Fuse UL time delay)	SERVOSTAR 640	SERVOSTAR 670
AC supply $F_{N1/2/3}$ **Type of branch circuit fuses: Class RK5, 480V min**	50 AT (FRx-50) *	80 AT (FRx-80) *
Regen resistor $F_{B1/2}$	KLM 20	KLM 30

* (x = S or S-R for 480V applications x = N or N-R for 230V applications ⇨ p. 10)

Note: The SERVOSTAR 640/670 drives are suitable for use on a circuit capable of delivering not more than 5000rms symmetrical amperes, 480VAC max.

I.7.2 Allowable ambient conditions, ventilation, mounting position

Storage temperature/humidity/duration	⇨ p.81
Transport temperature / humidity	⇨ p.81
Supply voltage tolerances Input power (⇨ p.14)  Aux. power supply	min 3x230V$_{-10\%}$ AC / max 3x 480V$^{+10\%}$, 50 Hz min 3x208V$_{-10\%}$ AC / max 3x 480V$^{+10\%}$, 60 Hz 24 VDC (-0% +15%)
Ambient temperature in operation	0 to +45°C (32 to 113 °F) at rated data +45 to +55°C (113 to 131 °F) with power derating 2.5% / K
Humidity in operation	rel. humidity 85%, no condensation
Site altitude	up to 1000m a.m.s.l. without restriction 1000 — 2500m a.m.s.l. with power derating 1.5%/100m
Pollution level	Pollution level 2 to EN60204/EN50178
Enclosure protection	IP 20
Mounting position	generally vertical. ⇨ p.28
Ventilation	forced convection by built-in fans
Make sure that there is sufficient forced ventilation within the switchgear cabinet.	

I.7.3 Conductor cross-sections

Following EN 60204 (for AWG: table 310-16 of the NEC 60°C or 75°C column), we recommend for **single-axis systems**:

AC connection	25 mm² (2 awg), shielded between filter and amplifier, 600V,105°C (221°F)
DC-link	25 mm² (2 awg), shielded for lengths > 20 cm, 600V,105°C (221°F)
Motor cables	⇨ p.41, cross section see manual of the used motor series, capacitance <250pF/m, 600V,105°C (221°F)
Resolver, thermostat-motor	4x2x0.25 mm² (22awg) twisted pairs, shielded, max.100m, capacitance <120pF/m
Encoder, thermostat-motor	7x2x0,25 mm² (22awg) twisted pairs, shielded, max.50m, capacitance <120pF/m
Setpoints, monitors, AGND	0.25 mm² (22awg) twisted pairs, shielded
Control signals, BTB, DGND	0.5 mm² (20 awg)
Holding brake (motor)	min. 1.5 mm² (18 awg), 600V,105°C (221°F), shielded, check voltage drop
+24 V / XGND	max. 2.5 mm² (14 awg), check voltage drop
Regen resistor	⇨ p.41, min. 10 mm² (6 awg), shielded, 1000V,105°C (221°F)
For multi-axis systems, please note the special operating conditions in your installation	

Technical data for connection cables ⇨ p. 36. Observe our application note “Cables and connectors”.

I.7.4 Recommended torques

Connector	Recommended torque
X3, X4	0.3 Nm(2.25 in lb)
X10	0,3 Nm (2.25 in lb)
X0	6...8 Nm (45... 60 in lb)

I.7.5 LED display

A 3-character LED display shows the amplifier status after switching on the 24V supply (⇨ p.61). During operation and parameter setting of the amplifier via the keys on the front panel, the parameter and function numbers (⇨ p.61) are displayed, as well as the numbers of any errors which occur (⇨ p.62).

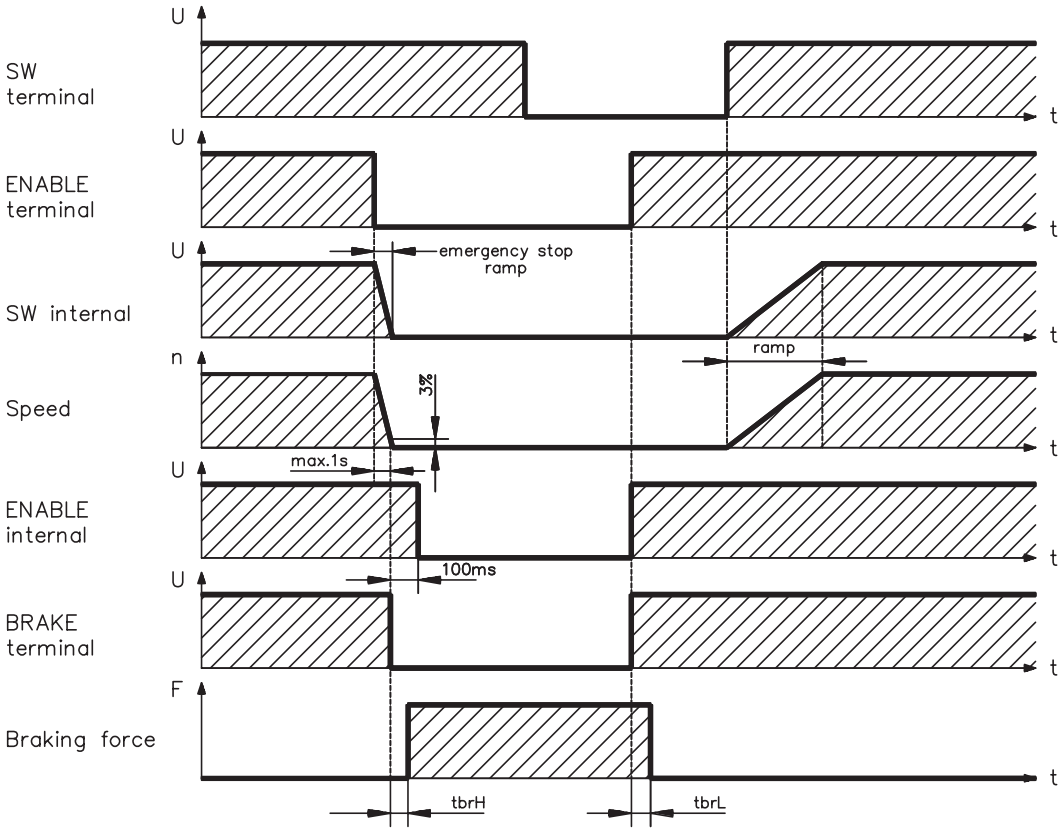
I.8 Grounding system

AGND — ground for analog inputs/outputs, internal analog/µC ground
DGND — ground for digital inputs/outputs, optically isolated
XGND — ground for external 24V aux. voltage, optically and inductively isolated
PGND — ground for encoder emulation, RS232, CAN, PROFIBUS, optically isolated

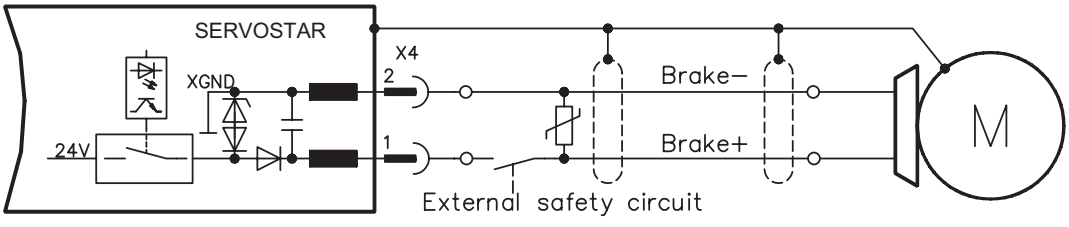
The potential isolation is shown in the block diagram (⇨ p. 14).

I.9 Control for motor-holding brake

A 24V / max. 2A holding brake in the motor can be controlled directly by the servo amplifier. **This function does not ensure personnel safety!** The brake function must be enabled through the BRAKE parameter (setting: WITH BRAKE). In the diagram below you can see the time and functional relationships between the ENABLE signal, speed setpoint, speed and braking force.



During the internal ENABLE delay time of 100ms the speed setpoint of the servo amplifier is internally driven down a 10ms ramp to 0V. The brake output is switched on when 3% of the final speed is reached. The rise (tbrH) and fall (tbrL) times of the holding brake which is built into the motors are different for the various types of motor (see motor manual). A description of the interface can be found on page 41.
A safe (for personnel) operation of the holding brake requires an additional “make” (n.o.) contact in the brake circuit and a suppressor device (varistor) for the recommended brake circuit diagram :



I.10 Regen circuit

During braking with the aid of the motor, energy is fed back to the servo amplifier. This energy is converted into heat in the regen resistor. The regen resistor is switched into circuit by the regen circuit. The regen circuit (thresholds) are adjusted to the supply voltage with the help of the setup software.
Our customer service can help you with the calculation of the regen power which is required. A description of the interface can be found on page 41 .

Functional description:

1.- Individual amplifiers, **not coupled** through the DC-link (DC+, DC-)

The circuit starts to respond at a DC-link voltage of 400V, 720V or 840V (depending on the supply voltage). If the energy which is fed back from the motor, as an average over time or as a peak value, is higher than the preset regen power, then the servo amplifier will output the status “regen power exceeded” and the regen circuit will be switched off. At the next internal check of the DC-link voltage (after a few ms) an overvoltage will be detected and the Servo amplifier will be switched off with the error message “Overvoltage F02” (⇨ p. 62). The BTB/RTO contact (terminal X3/2,3) will be opened at the same time (⇨ p. 47).

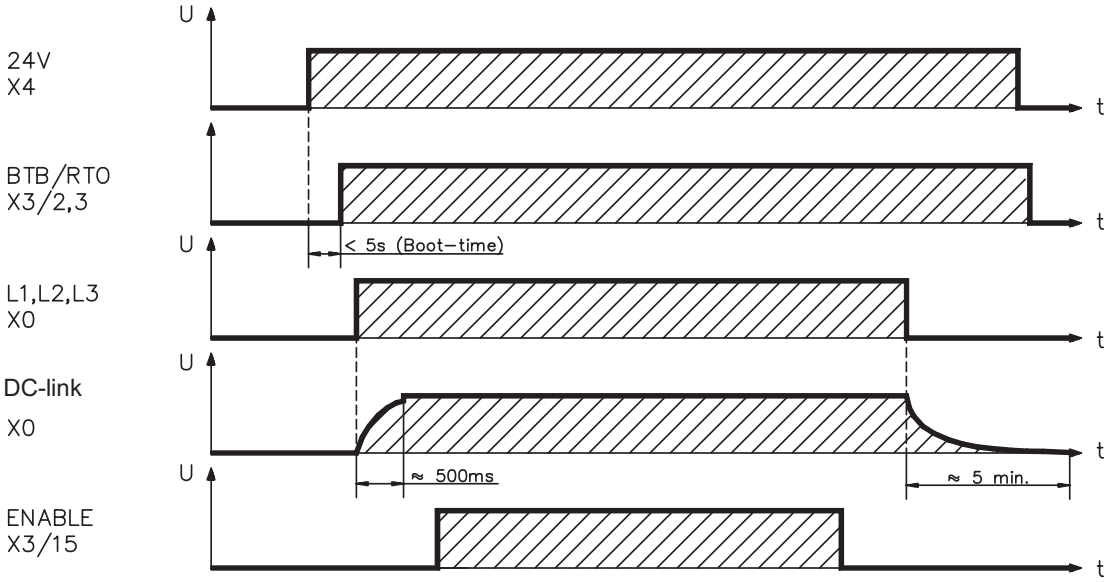
2.- Several servo amplifiers **coupled** through the DC-link circuit (DC+, DC-)

Thanks to the built-in regen circuit with its patented power distribution, several amplifiers (even with different current ratings) can be operated off a common DC-link. This is achieved by an automatic adjustment of the regen thresholds (which vary, because of tolerances).
The regen energy is distributed equally among all the amplifiers. The **combined power** of all the amplifiers is always available, as continuous or peak power. The switch-off takes place as described under 1. (above) for the servo amplifier with the lowest switch-off threshold (resulting from tolerances).
The RTO (BTB) contact of this amplifier (terminals X3/2,3) will be opened at the same time (⇨ p. 47).

Regen circuit: technical data			**SERVOSTAR**	
Supply voltage	**Rated data**	**DIM**	**640**	**670**
3 x 230 V	External regen resistor	Ohm	15	10
	Upper switch-on level of regen circuit	V	400 - 430	
	Switch-off level of regen circuit	V	380 - 410	
	Overvoltage F02	V	450	
	Continuous power of regen circuit (R_{Bext}) max.	kW	6	
	Pulse power, external (R_{Bext} max. 1s)	kW	10	16
3 x 400 V	External regen resistor	Ohm	15	10
	Upper switch-on level of regen circuit	V	720 - 750	
	Switch-off level of regen circuit	V	680 - 710	
	Overvoltage F02	V	800	
	Continuous power of regen circuit (R_{Bext}) max.	kW	6	
	Pulse power, external (R_{Bext} max. 1s)	kW	35	50
3 x 480 V	External regen resistor	Ohm	15	10
	Upper switch-on level of regen circuit	V	840 - 870	
	Switch-off level of regen circuit	V	800 - 830	
	Overvoltage F02	V	900	
	Continuous power of regen circuit (R_{Bext}) max.	kW	6	
	Pulse power, external (R_{Bext} max. 1s)	kW	45	70

I.11 Switch-on and switch-off behavior

The diagram below illustrates the correct functional sequence for switching the servo amplifier on and off.



I.11.1 Stop function to EN 60204 (VDE 0113)

If a fault occurs (⇨ p. 62) the output stage of the servo amplifier is switched off and the BTB/RTO contact is opened. In addition, a global error signal can be given out at one of the digital outputs (terminals X3/16 and X3/17) (see online help for the setup software). These signals can be used by the higher-level control to finish the current PLC cycle or to shut down the drive (with additional brake or similar.).

The built-in restart lock -AS- can be used to switch off the drive via a positive-action (approved by Trade Liability Association) safety relay, so that personnel safety is ensured at the drive shaft (⇨ p. 22).

Instruments which are equipped with a selected “Brake” function use a special sequence for switching off the output stage (⇨ p. 18).

The Stop functions are defined in EN 60204 (VDE 0113), Para. 9.2.2, 9.2.5.3.

There are three categories of Stop functions:

- Category 0: Shut down by immediately switching off the supply of energy to the drive machinery (i.e an uncontrolled shut-down);
- Category 1: A controlled shut-down, during which the supply of energy to the drive machinery is maintained to perform the shut-down, and where the energy supply is only interrupted when the shut-down has been completed;
- Category 2: A controlled shut-down, where the supply of energy to the drive machinery is maintained.

Every machine must be equipped with a Stop function to Category 0. Stop functions to Categories 1 and/or 2 must be provided if the safety or functional requirements of the machine make this necessary.

You can find additional information and implementation examples in our application note “Stop and Emergency Stop functions with SERVOSTAR 600”.

I.11.2 Emergency Stop strategies

The Emergency Stop function is defined in EN 60204 (VDE 0113), Para. 9.2.5.4.

Implementation of the Emergency Stop function :

You can find wiring recommendations in our application note
"Stop and Emergency Stop functions with SERVOSTAR 600"

Category 0:

The controller is switched to "disable", the electrical supply (208...480VAC) is disconnected.

The drive must be held by an electromagnetic holding device (brake).

In multiaxis systems with connected DC-link bus (intermediate circuit) the motor leads have to be disconnected by a changeover switch (contactor, e.g. Siemens 3RT1516-1BB40) and short-circuited by resistors connected in a star configuration.

Category 1:

If hazardous conditions can result from an emergency stop switch-off with an unbraked run-down, then the drive can be switched off by a controlled shut-down.
Stop Category 1 permits electromotive braking with a switch-off when zero speed has been reached. Safe shut-down can be achieved, when the loss of the mains supply is not rated as a fault and the control takes over the disabling of the servoamplifier.
In the normal situation, only the supply power is switched off in a safe manner.
The 24V auxiliary supply remains switched on.

I.12 Restart lock -AS-

I.12.1 Advantages of the restart lock

A frequently required application task is the protection of personnel against the restarting of drives. This can not be achieved by an electronic inhibit, but must be implemented with mechanical elements (positively driven relay contacts).
To get round this problem, up to now either the main contactor in the mains supply line was switched off, or another contactor was used to disconnect the motor from the servo amplifier.

The disadvantages of this method are :

- the DC-link has to be charged up again at restart
- wear on the contacts of the contactors, caused by switching under load
- extensive wiring required, with additional switching components

The restart lock -AS- avoids these disadvantages. A safety relay in the servo amplifier is activated either by the PLC or manually. Positively driven contacts provide a safe disconnection of the amplifier, the setpoint input of the servo amplifier is inhibited, and a signal is sent to the safety circuit.

The suggested circuits (⇨ p. 25) fulfills safety category 1 (EN 954-1). You can fulfill safety category 3, if you use a mains contactor with suited supervision.

Advantages of the restart lock -AS- :

- the DC-link remains charged up, since the mains supply line remains active
- only low voltages are switched, so there is no contact wear
- very little wiring is required
- the functionality and the personnel safety when using the circuit recommendations in this documentation have been approved by the Trade Liability Association.

I.12.2 Functional description

The connector (X10) is mounted on the front panel of the SERVOSTAR 640/670.The coil connections and a make (n.o.) contact of a safety relay are made available through 4 terminals on this connector.

The 24VDC safety relay in the servo amplifier (approved) is controlled externally. All the relay contacts have positive action.

Two contacts switch off the driver supply of the output stage in the servo amplifier, and short the internal setpoint signal to AGND (0 V).

The make (n.o.) contact used for monitoring is looped into the control circuit.

If the safety relay is not energized, then the monitoring contact is open and the servo amplifier is ready for operation.

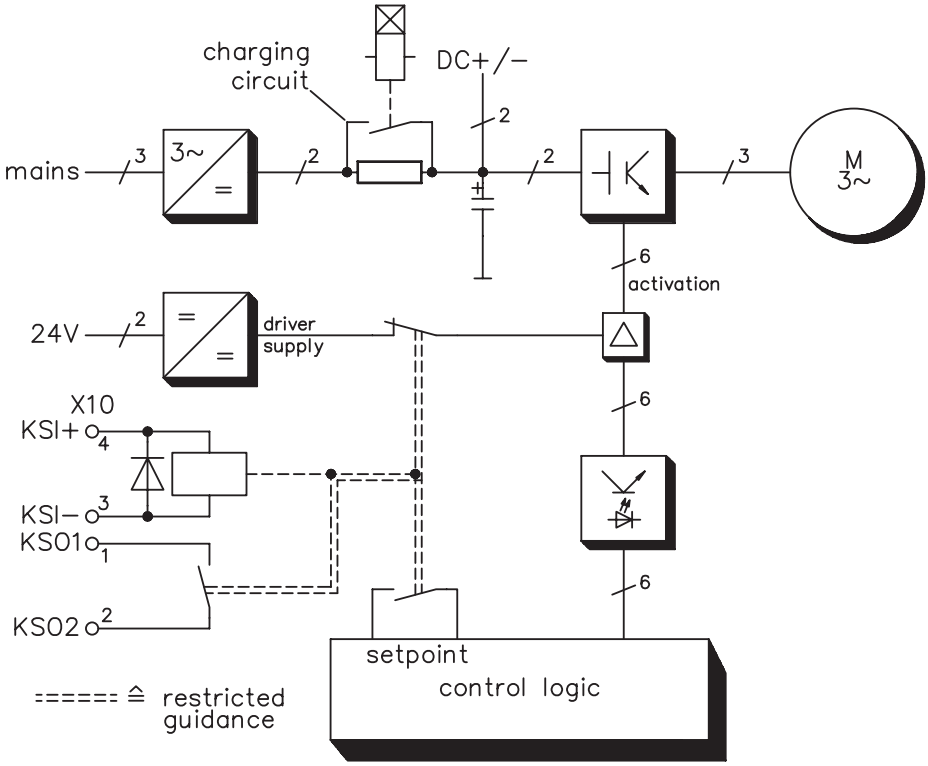
If the drive is electronically braked, the servo amplifier is disabled and the motor-holding brake is on, then the safety relay is energized (manually or by the controls).

The supply voltage for the driver circuit of the output stage is switched off in a safe manner, the internal setpoint is shorted to 0V, and the monitoring contact bridges the safety logic in the control circuit of the system (monitoring of protective doors etc.)

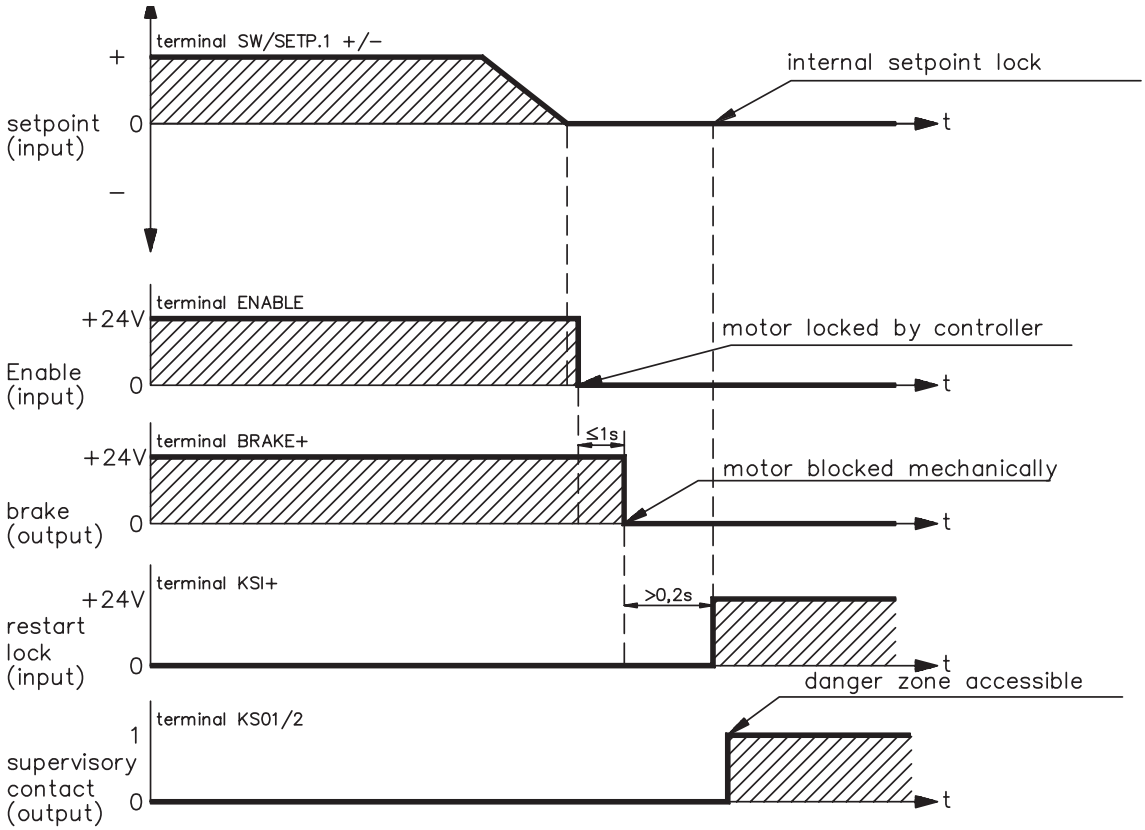
Even if the output stage or driver is destroyed, it is impossible to start the motor.

If the safety relay itself is faulty, then the monitoring contact cannot bridge the safety logic of the system. Opening the protective devices will then switch off the system.

I.12.3 Block diagram



I.12.4 Signal diagram (sequence)



I.12.5 Installation / Setup

I.12.5.1 Safety instructions

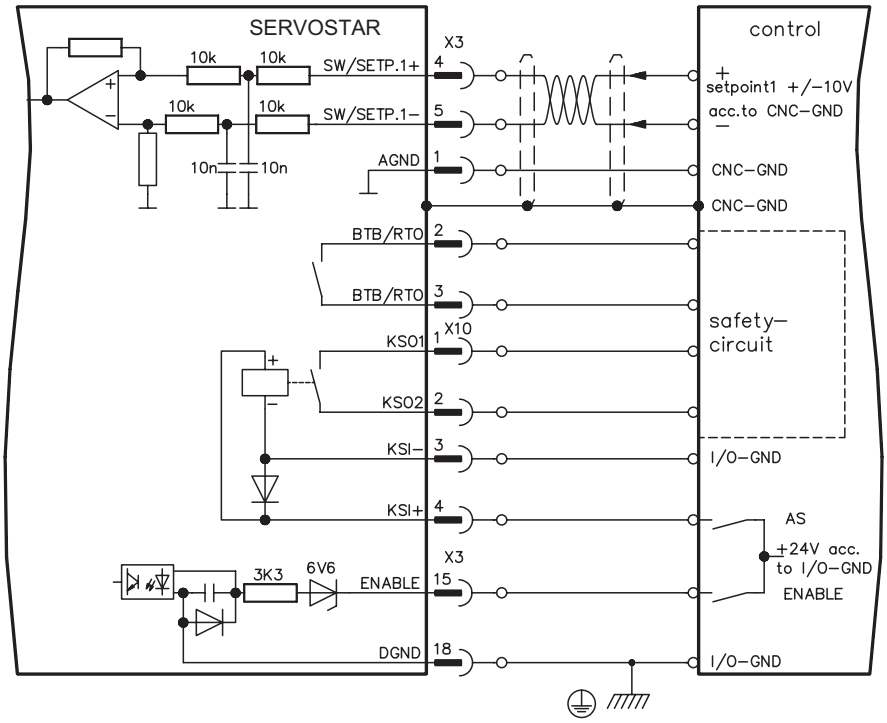
- Observe the prescribed use of the restart lock -AS- (⇨ p. 10)
- The monitoring contacts (KSO1/2) for each amplifier must be looped into the control circuit. This is vital, so that a malfunction of the internal safety relay or a cable break can be recognized.
- If the restart lock -AS- is automatically activated by a control system (KSI1/2), then make sure that the output of the control is monitored for possible malfunction. This can be used to prevent a faulty output from activating the restart lock -AS- while the motor is running.
- **Keep to the following functional sequence when the restart lock -AS- is used :**
  1. Brake the drive in a controlled manner (speed setpoint = 0V)
  2. When speed = 0 rpm, disable the servo amplifier (enable = 0V)
  3. If there is a suspended load, apply an additional mechanical block to the drive
  4. Activate the restart lock -AS-

I.12.5.2 Functional test

The functioning of the restart lock **must** be tested during setup, after every alteration in the wiring of the system, or after exchanging one or more components of the system.

1. Stop all drives, with setpoint 0V, disable drives, mechanically block any suspended loads
2. Activate the restart lock -AS-.
3. Open protective screens (but do not enter hazardous area)
4. Pull off the X10 connector from an amplifier: **the mains contactor must drop out**
5. Reconnect X10. Switch on mains contactor again.
6. Repeat steps 4 and 5 for each individual servo amplifier.

I.12.5.3 Connection diagram



I.12.6 Application examples

I.12.6.1 Moving single axes or axis-groups in setting-up operation

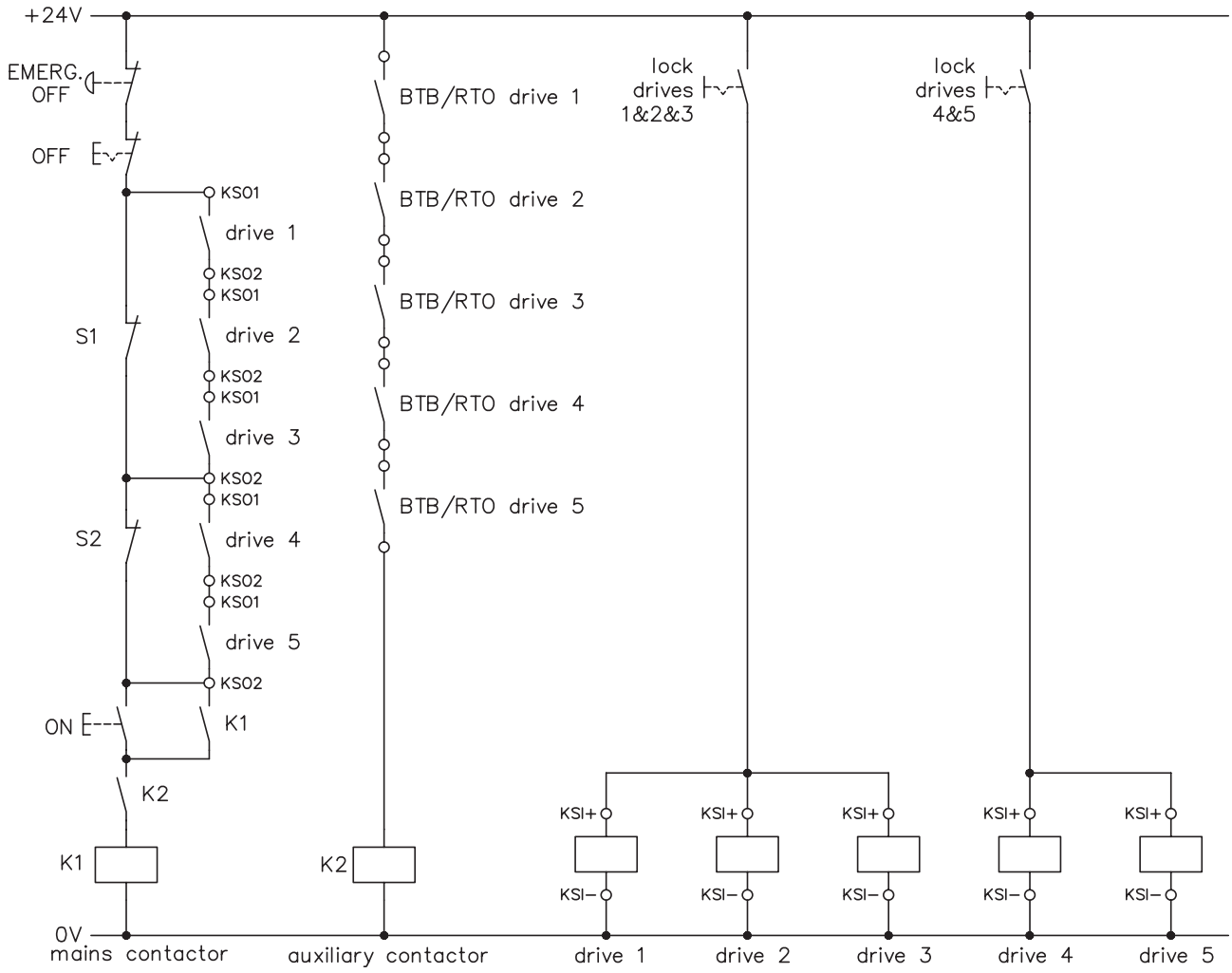
In setting-up operation, people will frequently be within the danger zone of the machinery. Axes will normally be moved under the control of permission switches. An additional switch-off of the unused axes, by means of the restart lock, increases the safety margin and avoids the repeated switching of main contactors or motor contactors.

I.12.6.2 Switching off grouped axes with separate working areas

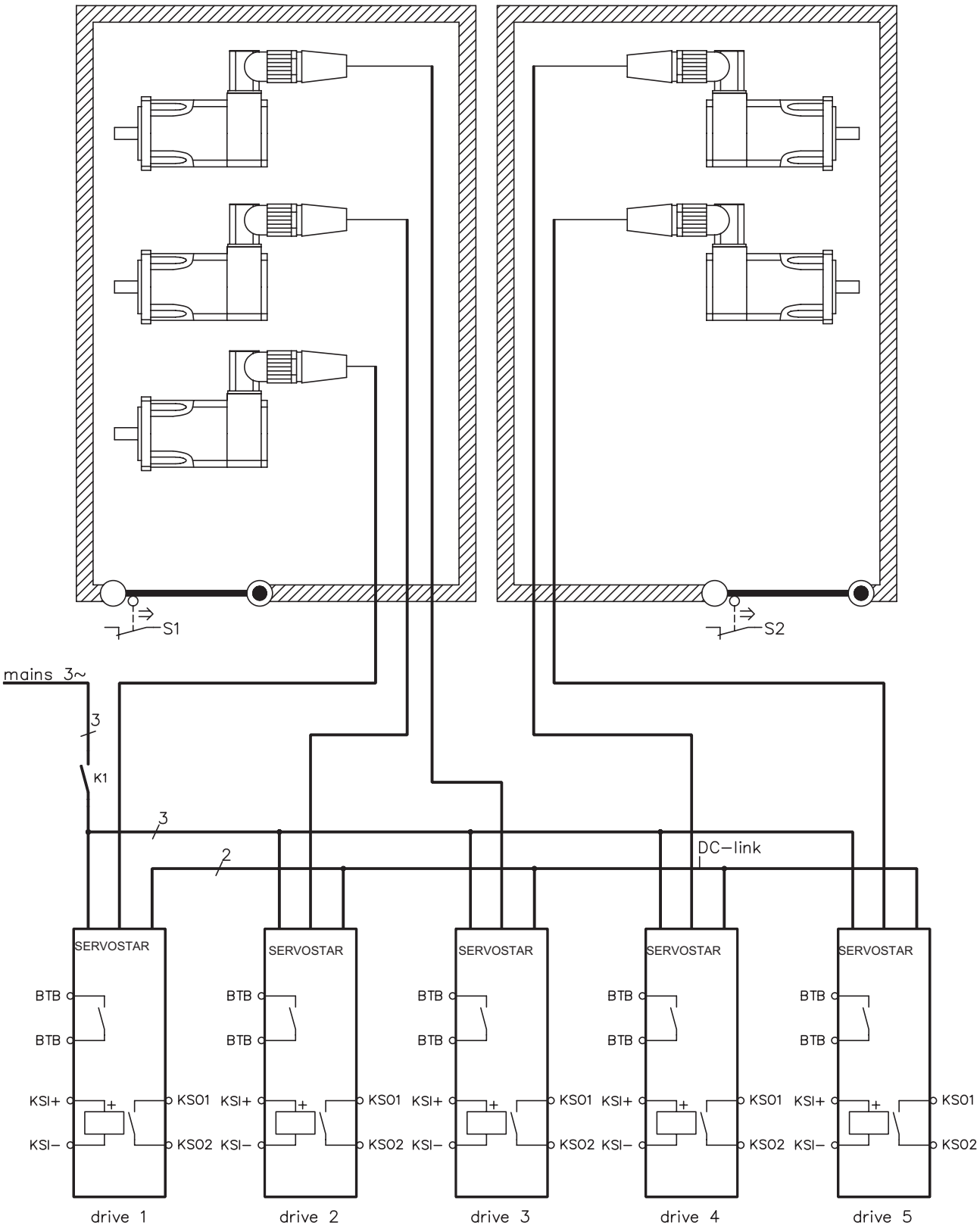
Even when several SERVOSTAR 640/670 are operating off a common mains supply and DC-link, it is possible to set up groups for separate working areas. These groups can then be switched off separately for personnel safety. For this purpose, we have provided you with a suggested circuit (mains supply circuit and control circuit for 2 separate working groups which have interconnected DC-links and a common mains supply voltage).

I.12.6.2.1 Control circuit

The suggested circuit fulfills safety category 1 (EN 954-1). You can fulfill safety category 3, if you use a mains contactor with suited supervision.



I.12.6.2.2 Mains supply circuit



II Installation

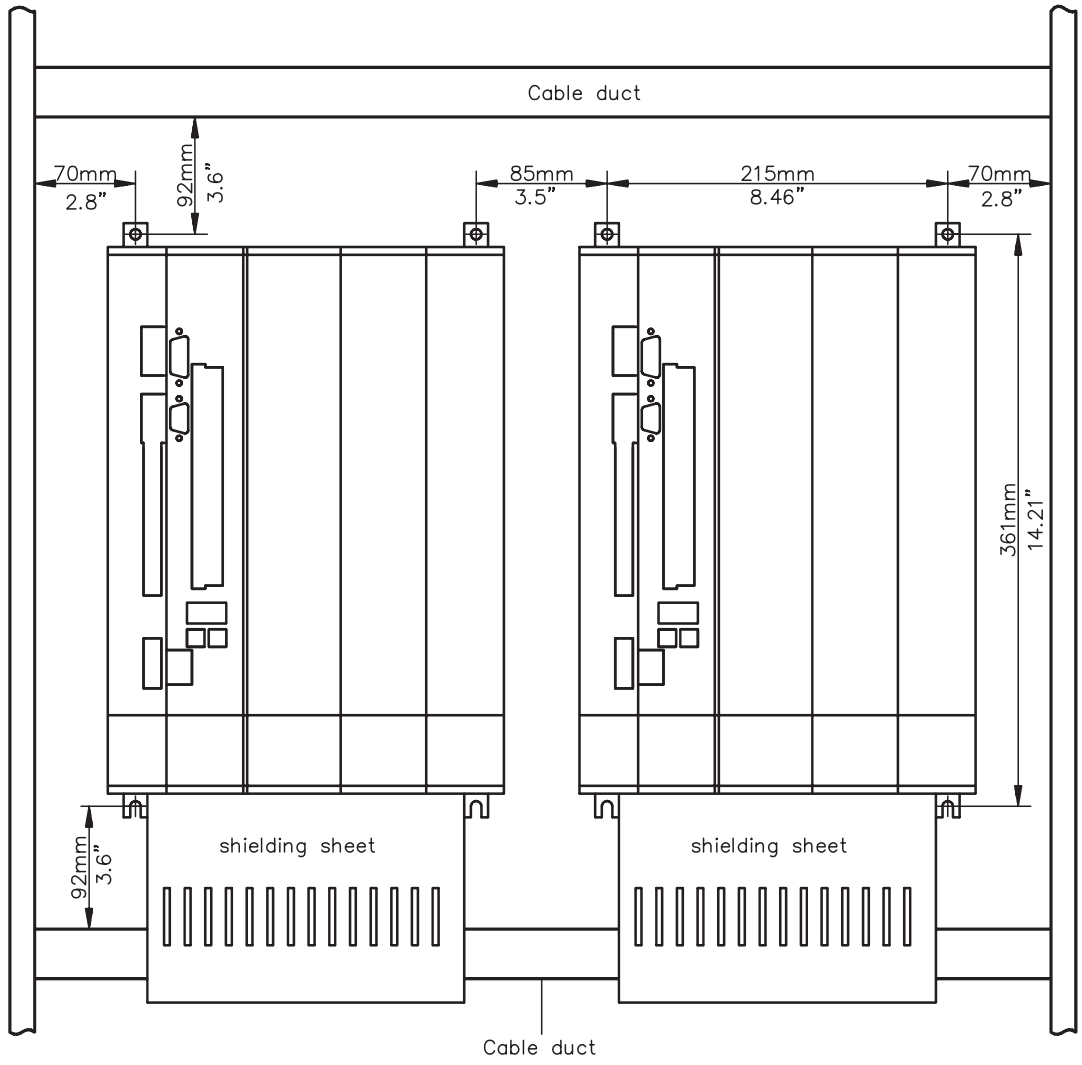
II.1 Important instructions

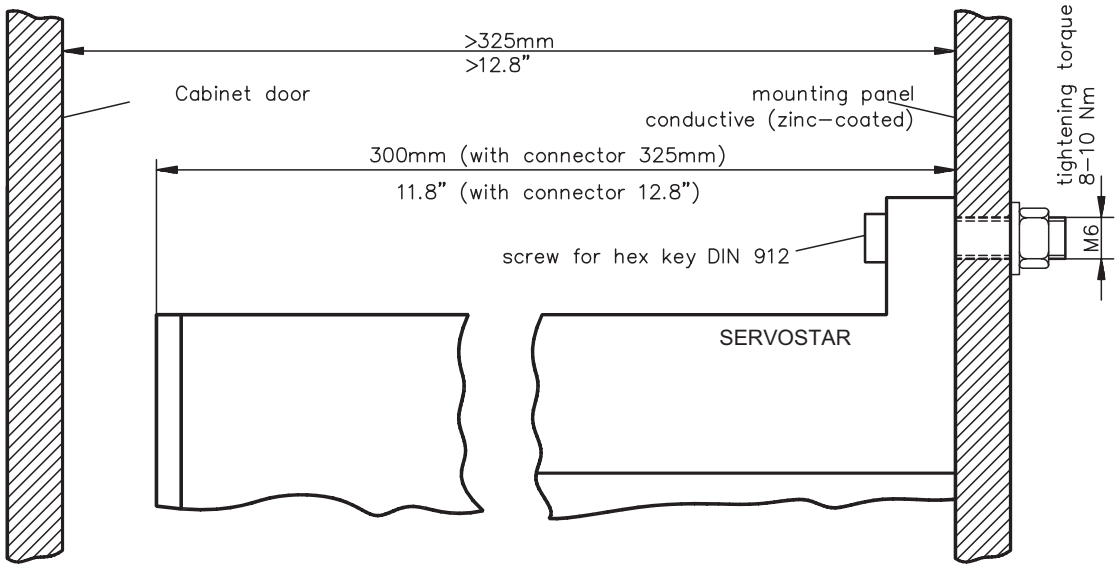
- Protect the servo amplifier from impermissible stresses. In particular, do not let any components become bent or any insulation distances altered during transport and handling. Avoid contact with electronic components and contacts.
- Check the combination of servo amplifier and motor. Compare the rated voltage and current of the units. Carry out the wiring according to the connection diagram on page 30.
- Make sure that the maximum permissible rated voltage at the terminals L1, L2, L3 or +DC, –DC is not exceeded by more than 10% even in the most unfavourable case (see EN 60204-1 Section 4.3.1). An excessive voltage on these terminals can lead to destruction of the regen circuit and the servo amplifier. Use the SERVOSTAR 640/670 servo amplifiers only on an earthed (grounded) 3-phased supply system, to drive a synchronous servomotor.
- **The use of external mains chokes and mains filters is required.**
- The fusing of the AC supply input and the 24V supply is installed by the user (⇨ p. 16).
- Take care that the servo amplifier and motor are earthed (grounded) properly. Do **not** use painted (non-conductive) mounting plates.
- Route power and control cables separately. We recommend a separation of at least 200mm. This improves the interference immunity required by EMC regulations.
- Install all heavy-current cables with an adequate cross-section, as per EN 60204. (⇨ p. 17).
- Wire the BTB/RTO contact in series into the safety circuit of the installation. Only in this way is the monitoring of the servo amplifier assured.
- Install all shielding with large areas (low impedance), with metallised connector housings or shield connection clamps where possible.
  Earth (ground) the shielding at both ends (⇨ p. 32).
  Notes on connection techniques can be found on page 35 and in the application note “Cables and connectors”.
- Ensure that there is an adequate flow of cool, filtered air into the bottom of the switchgear cabinet. Observe page 17 .
- It is permissible to alter the servo amplifier settings by using the setup software.
  Any other alterations will invalidate the warranty.

Caution
Never disconnect the electrical connections to the servoamplifier while it is live. In unfavourable circumstances this could result in destruction of the electronics. Residual charges in the capacitors can have dangerous levels up to 300 seconds after switching off the mains supply voltage. Measure the voltage in the DC-link (+DC/-DC), and wait until the voltage has fallen below 40V.
Control and power connections can still be live, even when the motor is not rotating.

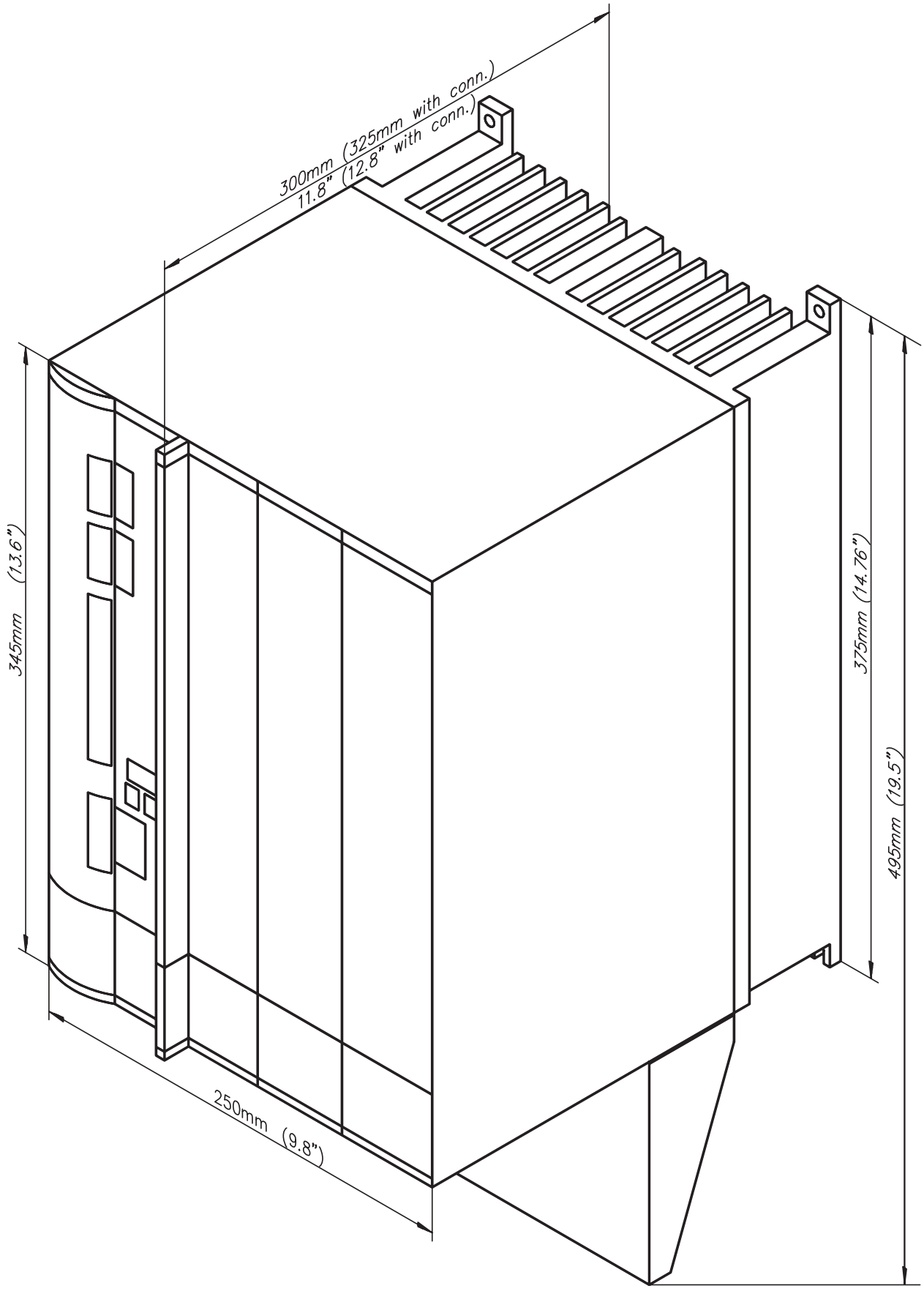
II.2 Assembly

Ask our customer service for information for pass through mounting
Material : 4 hexagon socket screws to DIN 912, M6
Tool required : 5 mm Allen key





II.2.1 Dimensions of SERVOSTAR 640/670



II.3 Wiring

Only professional staff who are qualified in electrical engineering are allowed to install the servo amplifier.

The installation procedure is described as an example. A different procedure may be sensible or necessary, depending on the application of the equipment.

We provide further know-how through **training courses** (on request).

Caution !
Only install and wire up the equipment when it is not live, i.e. when neither the mains power supply nor the 24 V auxiliary voltage nor the operating voltages of any other connected equipment is switched on.
Take care that the cabinet is safely disconnected (with a lock-out, warning signs etc.).
The individual voltages will be switched on for the first time during setup.

Note !

The ground symbol ⏚, which you will find in all the wiring diagrams, indicates that you must take care to provide an electrically conductive connection with the largest possible surface area between the unit indicated and the mounting plate in the switchgear cabinet.
This connection is for the effective grounding of HF interference, and must not be confused with the PE- symbol ⏚ (a protective measure to EN 60204).

Use the following connection diagrams:

— ***Restart lock -AS-*** ***: page 24***
— ***Power and control connections*** ***: page 32***
— ***Multi-axis systems, example*** ***: page 33***
— ***Resolver*** ***: page 42***
— ***High-resolution encoder*** ***: page 43***
— ***Encoder simulation ROD*** ***: page 48***
— ***Encoder simulation SSI*** ***: page 49***
— ***Master-slave interface*** ***: page 50***
— ***Pulse direction interface*** ***: page 52***
— ***RS232 / PC*** ***: page 54***
— ***CAN-interface*** ***: page 55***
— ***Expansion card -I/O-14/08-*** ***: Page 68***
— ***Expansion card PROFIBUS*** ***: Page 70***
— ***Expansion card SERCOS*** ***: Page 72***
— ***Expansion module -2CAN-*** ***: Page 74***

The following notes should assist you to carry out the installation in a sensible sequence, without overlooking anything important.

Site

In a closed switchgear cabinet. Observe page 17 .
The site must be free from conductive or corrosive materials.
For the mounting position in the cabinet ⇨ p. 28

Ventilation

Check that the ventilation of the servo amplifier is unimpeded and keep within the permitted ambient temperature ⇨ p. 17 .
Keep the required space clear above and below the servo amplifier ⇨ p 28.

Assembly

Assemble the servo amplifier and power supply, filter and choke close together on the conductive, **grounded** mounting plate in the cabinet.

Cable selection

Select cables according to EN 60204 (⇨ p. 17)

Grounding Shielding

EMC-compliant (EMI) shielding and grounding (⇨ p. 32)
Earth (ground) the mounting plate, motor housing and CNC-GND of the controls.
Notes on connection techniques are on page 35

Wiring

— **Route power leads and control cables separately**

— **Wire the BTB/RTO contact in series into the safety loop of the installation**

— Connect the digital control inputs to the servo amplifier

— Connect up AGND (also if fieldbuses are used)

— Connect the analog setpoint, if required

— Connect up the feedback unit (resolver and/or encoder)

— Connect the encoder emulation, if required

— Connect the expansion card (see corresponding manual on the CD-ROM)

— Connect the motor leads
Connect shielding to EMI connectors at both ends

— Connect motor-holding brake, connect shielding to EMI connectors at both ends

— Connect the external regen resistor (with fusing)

— Connect aux. supply
(for max. permissible voltage values ⇨ p. 17)

— Connect mains choke and mains filter (shielded lines between filter and servo amplifier)

— Connect main power supply
(for max. permissible voltage values ⇨ p. 17)

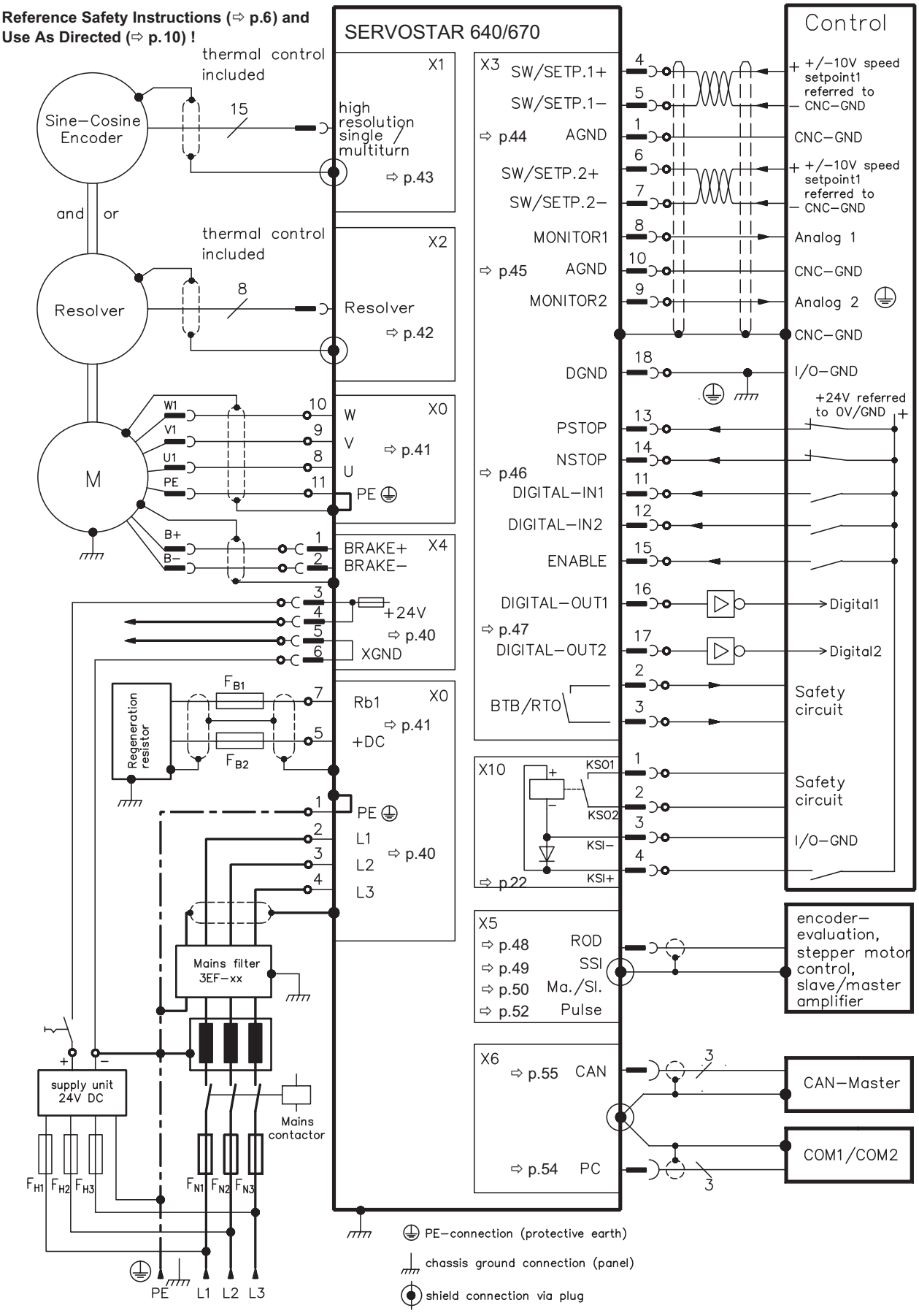
— Connect PC (⇨ p. 54).

Final check

— Final check of the implementation of the wiring, according to the wiring diagrams which have been used.

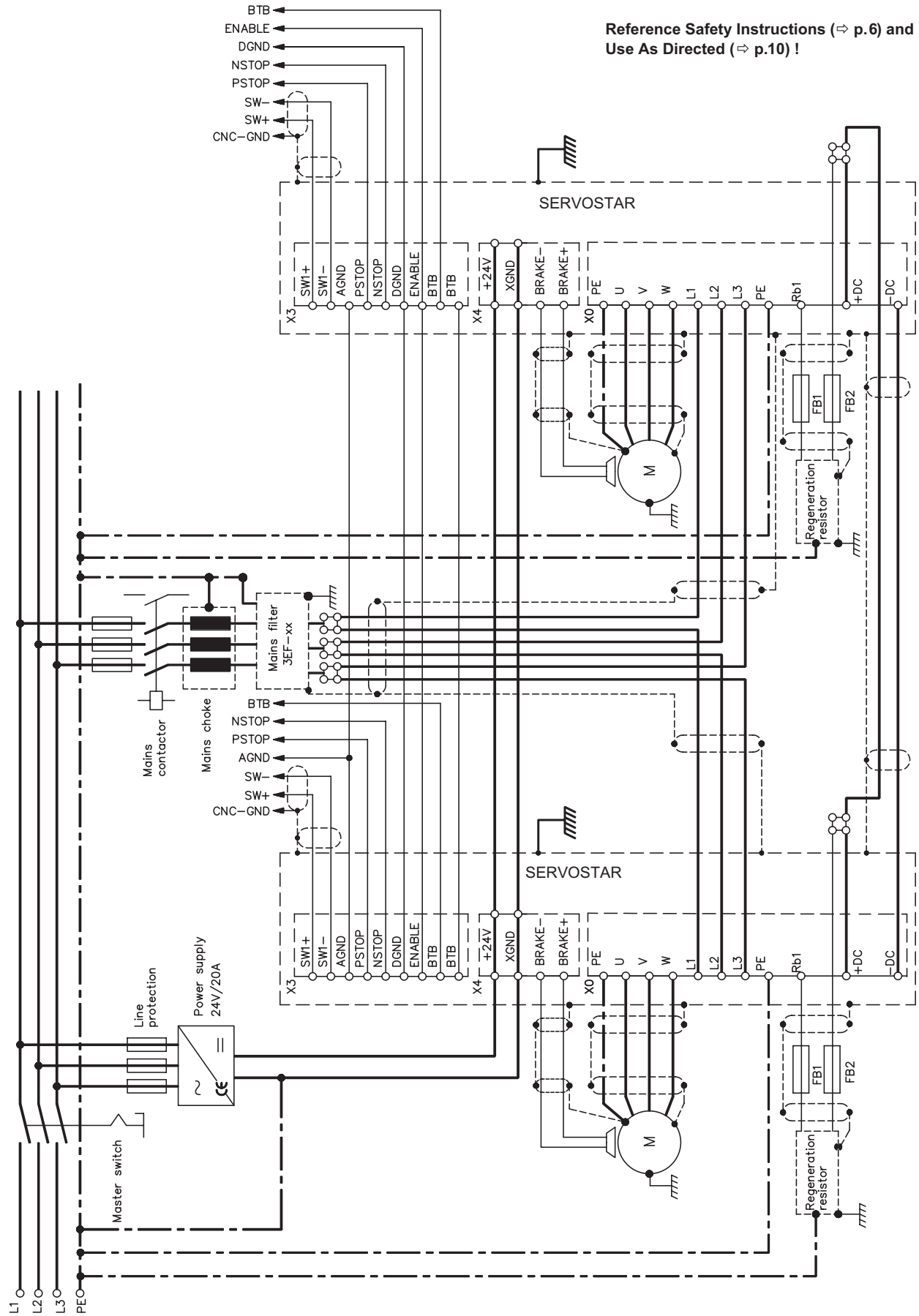
II.3.1 Connection diagram for SERVOSTAR 640/670

Reference Safety Instructions (⇨ p.6) and Use As Directed (⇨ p.10) !

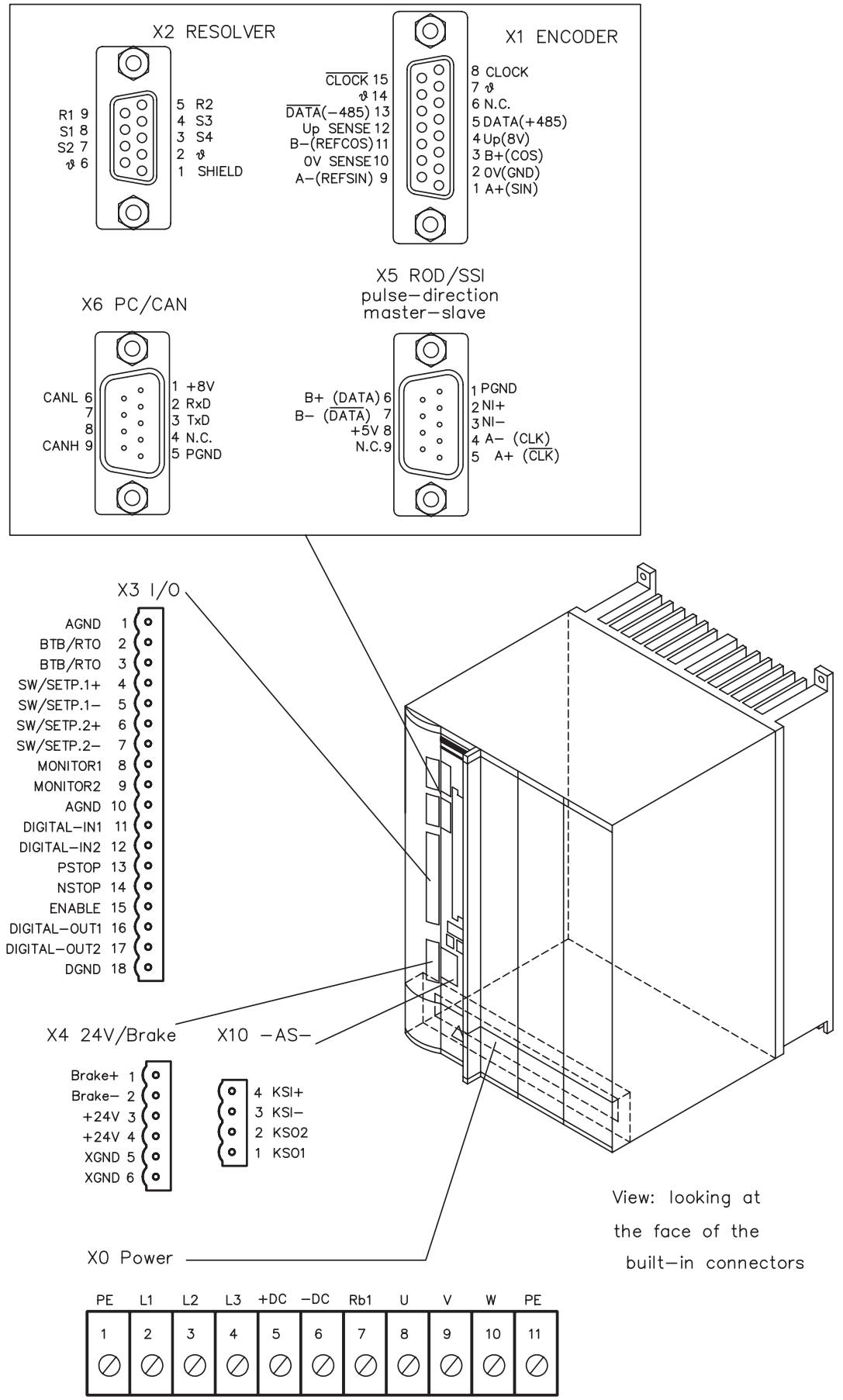


II.3.2 Example of connections for multi-axis system

Reference Safety Instructions (⇨ p.6) and Use As Directed (⇨ p.10) !



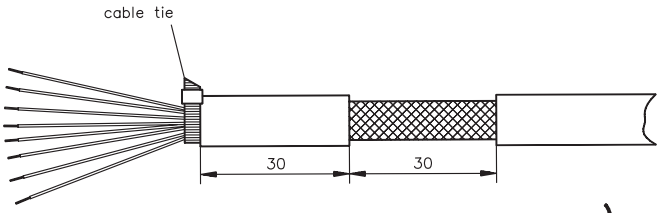
II.3.3 Pin assignments for SERVOSTAR 640/670



II.3.4 Notes on connection techniques

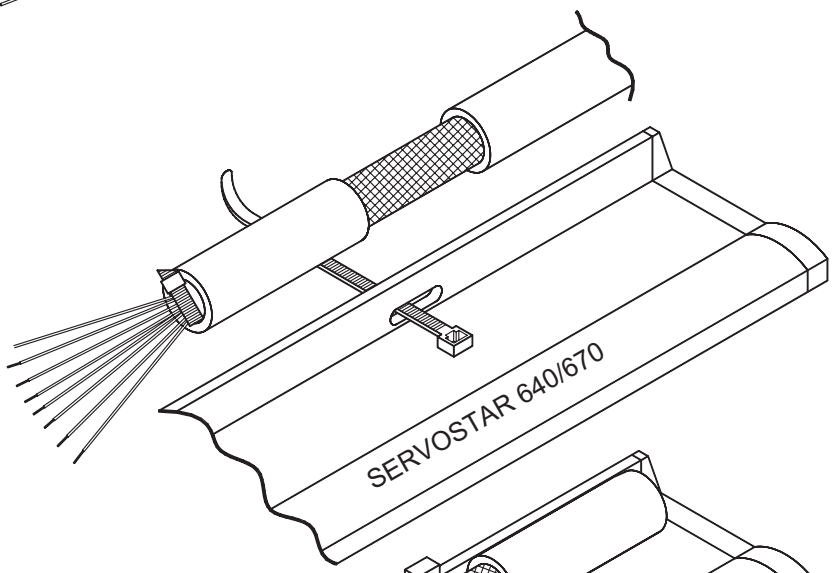
Please consider our application note “Cables and connectors”

II.3.4.1 Shielding connection to the front panel

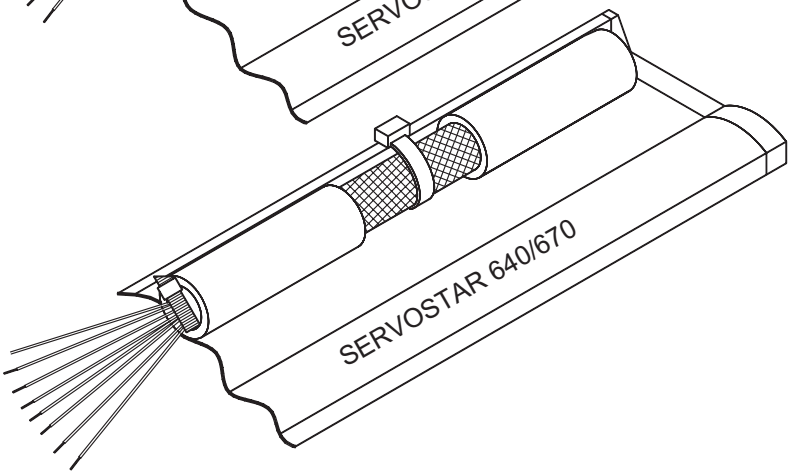


Remove the outer covering of the cable and the shielding braid from the cores for the required length. Secure the cores with a cable tie.

Remove the outer covering of the cable over a length of about 30mm, without damaging the shielding braid.



Pull a cable tie through the slot in the shielding rail (front panel) of the servo amplifier.



Use the cable tie to clamp the shielding braid of the cable firmly to the shielding rail.

II.3.4.2 Technical data for connecting cables

Further information on the chemical, mechanical and electrical characteristics of the cables can be obtained from out customer service .

Observe the restrictions in the chapter "Conductor cross-sections" on page 17 .

Insulation material

Sheathing	-	PUR (polyurethane, code 11Y)
Core insulation	-	PETP (polyesteraphtalate, code 12Y)

Capacitance

Motor cable	-	≤ 4mm² : less than 150 pF /m >4mm² : less than 250 pF/m
RES-cable	-	less than 120 pF/m

Technical data

— The brackets in the cable designation indicate the shielding.
— Alle cables are suitable for use as trailing cables.
— The technical data refer to the use as moveable cables.
Operating life : 1 million bending cycles

Cores [mm²]	Coretype	Operation-Temperature range [°C]	Operation-Temperature range [°F]	Outside diameter [mm]	Bending radius [mm]	Remarks
(4x1,0)	color	-30 / +80	-22 / 176	10,5	100	
(4x1,5)	letter	-30 / +80	-22 / 176	11,3	105	
(4x2,5)	number	-5 / +70	23 / 158	12,7	125	
(4x4)	number	-5 / +70	23 / 158	12,8	130	
(4x10)	number	-5 / +70	23 / 158	19	190	
(4x16)	number	-5 / +70	23 / 158	23,3	230	
(4x25)	number	-5 / +70	23 / 158	32,7	330	
(4x2x0,25)	color	-30 / +80	-22 / 176	6,9	60	twisted pairs
(7x2x0,25)	color	-30 / +80	-22 / 176	9,9	80	
(10x2x0,14)	color	-30 / +80	-22 / 176	8,8	80	

II.4 Setup software

II.4.1 General

This chapter describes the installation of the setup software for the SERVOSTAR 640/670 digital servo amplifiers.

We offer training and familiarisation courses on request.

II.4.1.1 Use as directed

The setup software is intended to be used for setting up and storing the operating parameters for the SERVOSTAR 640/670 series of servo amplifiers. The attached servo amplifier can be setup with the assistance of the software - during this process the drive can be controlled directly by the service functions.

Only professional personnel who have the relevant expertise described on page 9 are permitted to carry out online parameter setting for a drive which is running.
Sets of data which are stored on data media are not safe against unintended alteration by other persons. After loading a set of data you must therefore check all parameters thoroughly before enabling the servo amplifier.

II.4.1.2 Software description

The servo amplifiers must be adapted to the requirements of your installation. Usually you will not have to carry out this parameter setting yourself on the amplifier, but on a PC, with the assistance of the setup software. The PC is connected to the servo amplifier by a null-modem cable. The setup software provides the communication between SERVOSTAR 640/670 and the PC.

You will find the setup software on the accompanying CD-ROM and at the Danaher Motion web site in the Kollmorgen Seidel download area.

With very little effort you can alter parameters and instantly observe the effect on the drive, since there is a continuous (online) connection to the amplifier.
Simultaneously, important actual values are read out from the amplifier and displayed on the PC monitor (oscilloscope function).

Any interface modules (expansion cards) which may be built into the amplifier are automatically recognized, and the additional parameters which are required for position control or motion-block definition are made available.

Sets of data can be stored on data media (archived) and loaded again. Sets of data which are stored on data media can be printed.

We supply you with motor-specific default sets of data for the most common combinations of servo amplifier and motor. In most applications you will be able to use these default values to get your drive running without any problems.

II.4.1.3 Hardware requirements

The PC interface (X6, RS232) of the servo amplifier is connected to the serial interface of the PC by a null-modem cable (**not a null-modem link cable !**) (⇨ p. 54).

Connect / disconnect the interface cable only when the supply is switched off for both the PC and the servo amplifier.

The interface in the servo amplifier is electrically isolated by an optocoupler, and is at the same potential as the CANopen interface.

Minimum requirements for the PC:

Processor	:	80486 or higher
Operating system	:	WINDOWS 95(c) / 98 / 2000 / ME, WINDOWS NT4.0
Graphics adapter	:	Windows compatible, color
Drives	:	hard disk with at least 5 MB free space CD-ROM drive
Main memory	:	at least 8MB
Interface	:	one free serial interface (COM1:, :2, :3 or COM4:)

II.4.1.4 Operating systems

WINDOWS 95(c) / WINDOWS 98 / WINDOWS 2000 / WINDOWS ME / WINDOWS NT

DRIVE.EXE is executable under WINDOWS 95(c) / 98 / 2000 / ME and WINDOWS NT 4.0.
The HTML help system is **not** available under WINDOWS 95a and 95b.

WINDOWS FOR WORKGROUPS 3.xx, DOS, OS2

DRIVE.EXE is not executable under WINDOWS 3.xx, DOS and OS2.
In emergency, operation is possible through an ASCII terminal emulation (without user-interface).
Interface settings : 9600 bps, no parity, no handshake

Unix, Linux

The software function has not been tested running within Unix or Linux.

II.4.2 Installation under WINDOWS 95 / 98 / 2000 / ME / NT

An installation program called **SETUP.EXE** can be found on the CD-ROM which makes it easier to install the setup software on your PC.

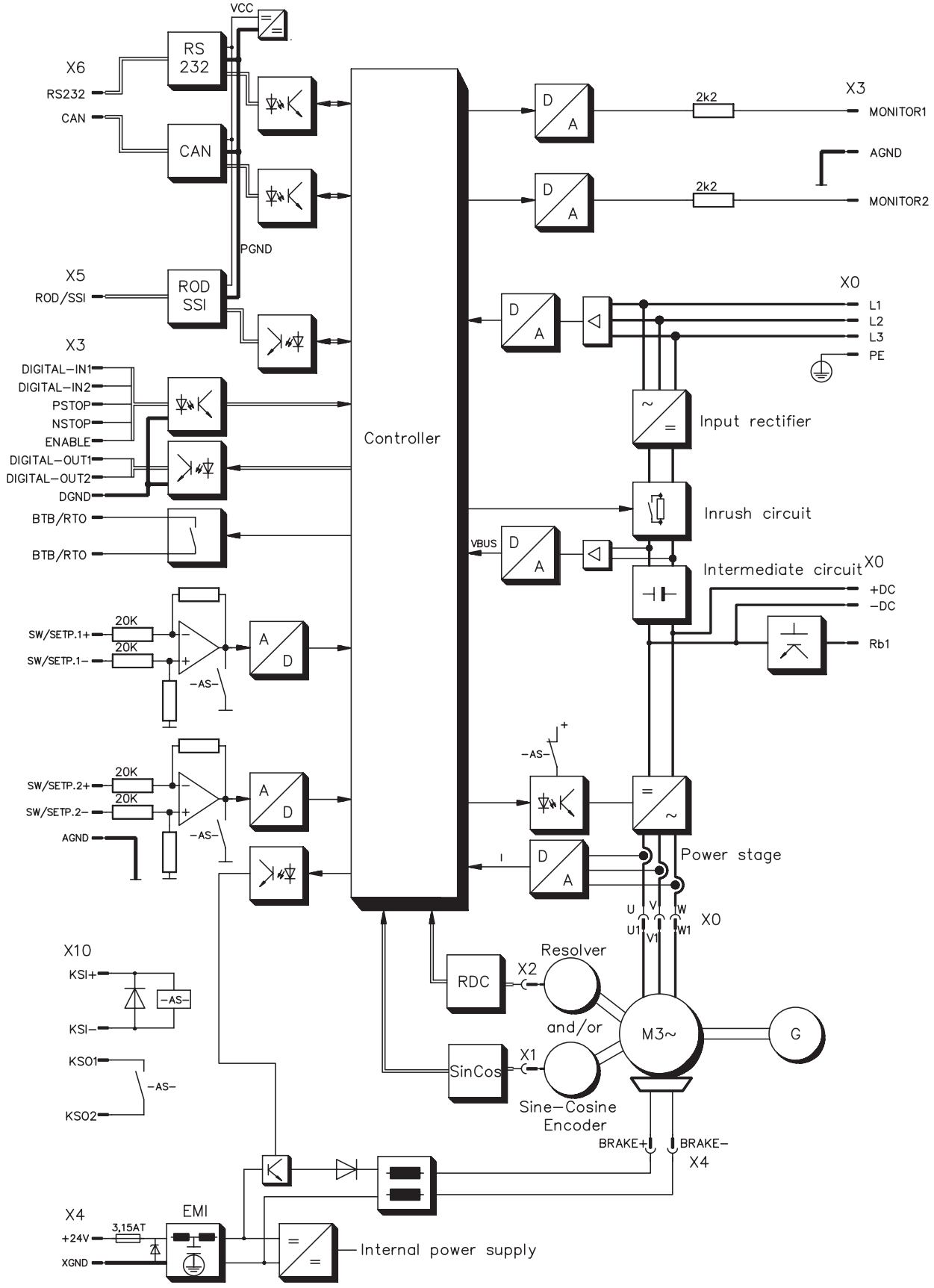
Connection to the serial interface of the PC:
Connect the interface cable to a serial interface on your PC and the PC interface (X6) of the SERVOSTAR 640/670 (⇨ p. 54).

Switch-on:
Switch on your PC-AT and the monitor.
After the start phase (boot-up) is finished, the Windows user-interface appears on the screen.

Installation:
Click on **START** (Task bar), then on **Run**. Enter the program call in the entry window:
x:\setup.exe (x= the correct CD-ROM drive letter).
Click on **OK** and follow the instructions.

III Interfaces

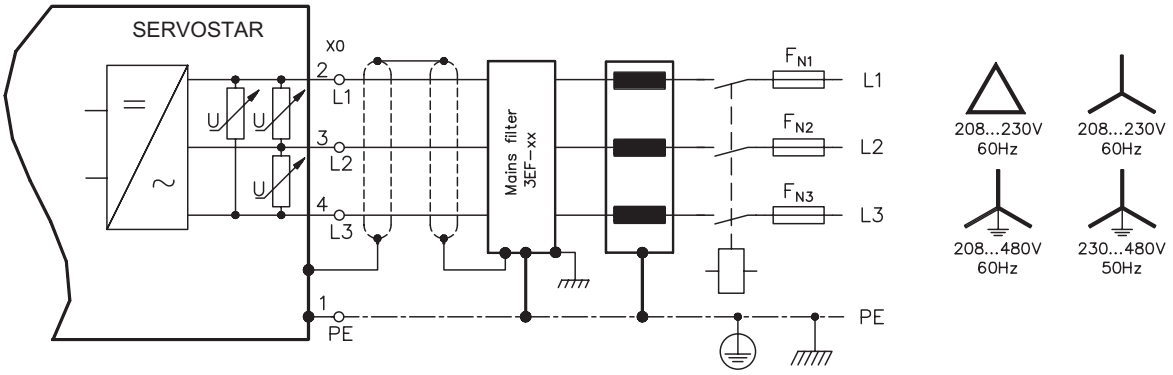
All important interfaces are shown in this chapter. The precise location of the connectors and terminals can be seen on page 34. The block diagram below is just an overview.



III.1 Power supply

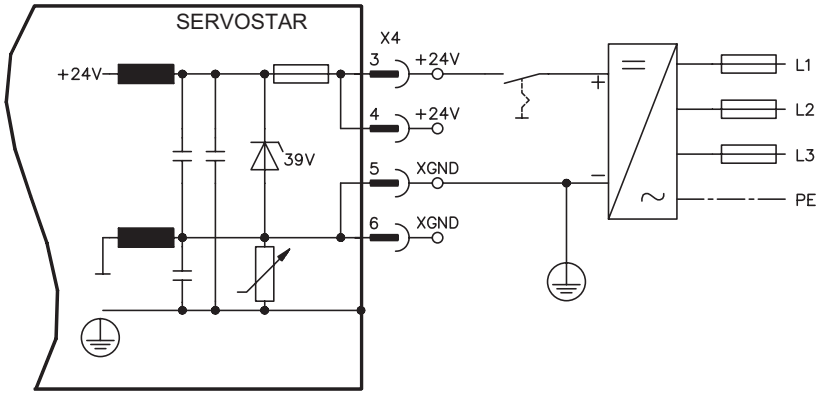
III.1.1 Mains supply connection (X0)

— EMI filter and mains choke (required) provided by the user
— Fusing (e.g. fusible cut-outs) provided by the user ⇨ p. 16



III.1.2 24V auxiliary supply (X4)

— Electrically isolated, external 24VDC supply, e.g. with insulating transformer
— Required current rating ⇨ p. 16
— Integrated EMI filter for the 24V auxiliary supply

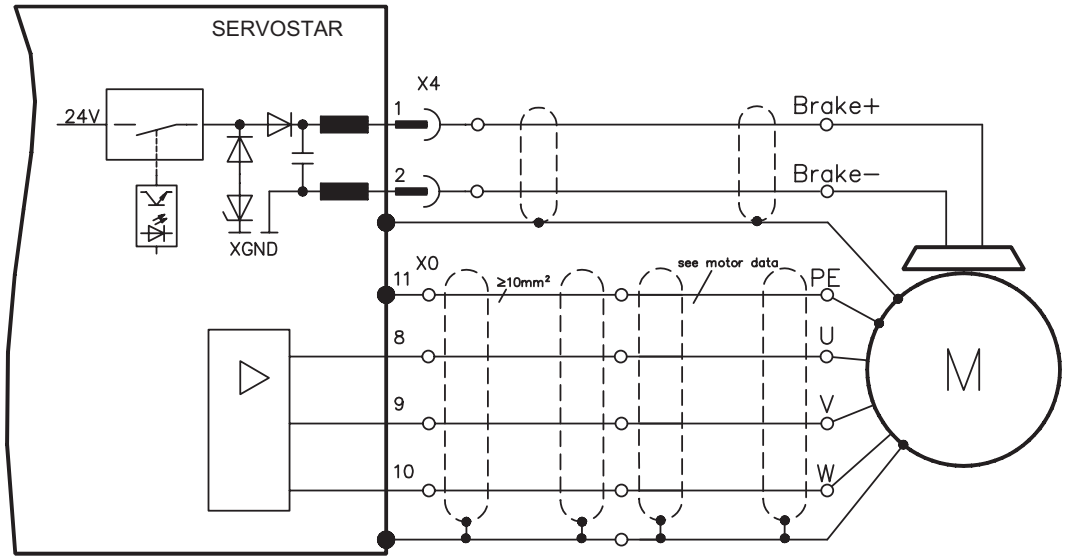


III.1.3 DC-link (X7)

Can be connected in parallel, thanks to patented circuit to distribute the regen power among all the amplifiers connected to the same DC-link circuit. (Connection example ⇨ p. 33).

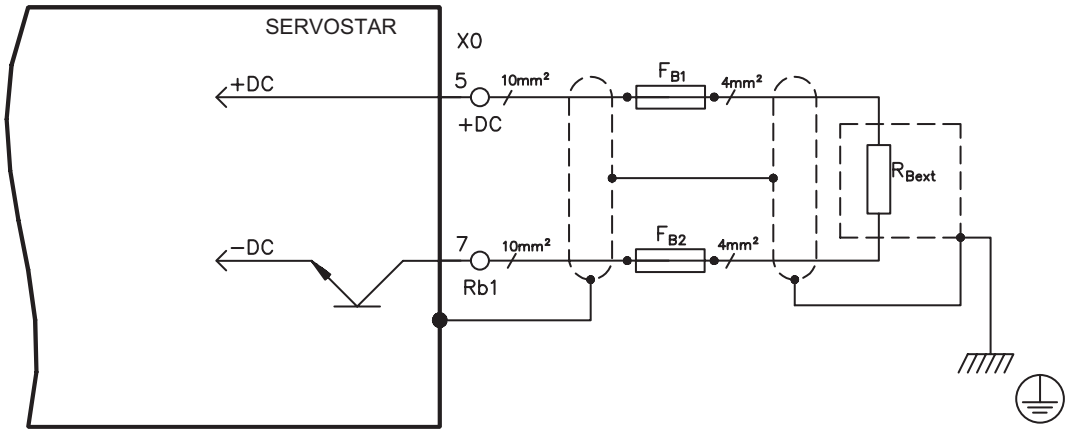
III.2 Motor connection with brake (X0, X4)

Cross section see manual of the motor series.



III.3 External regen resistor (X0)

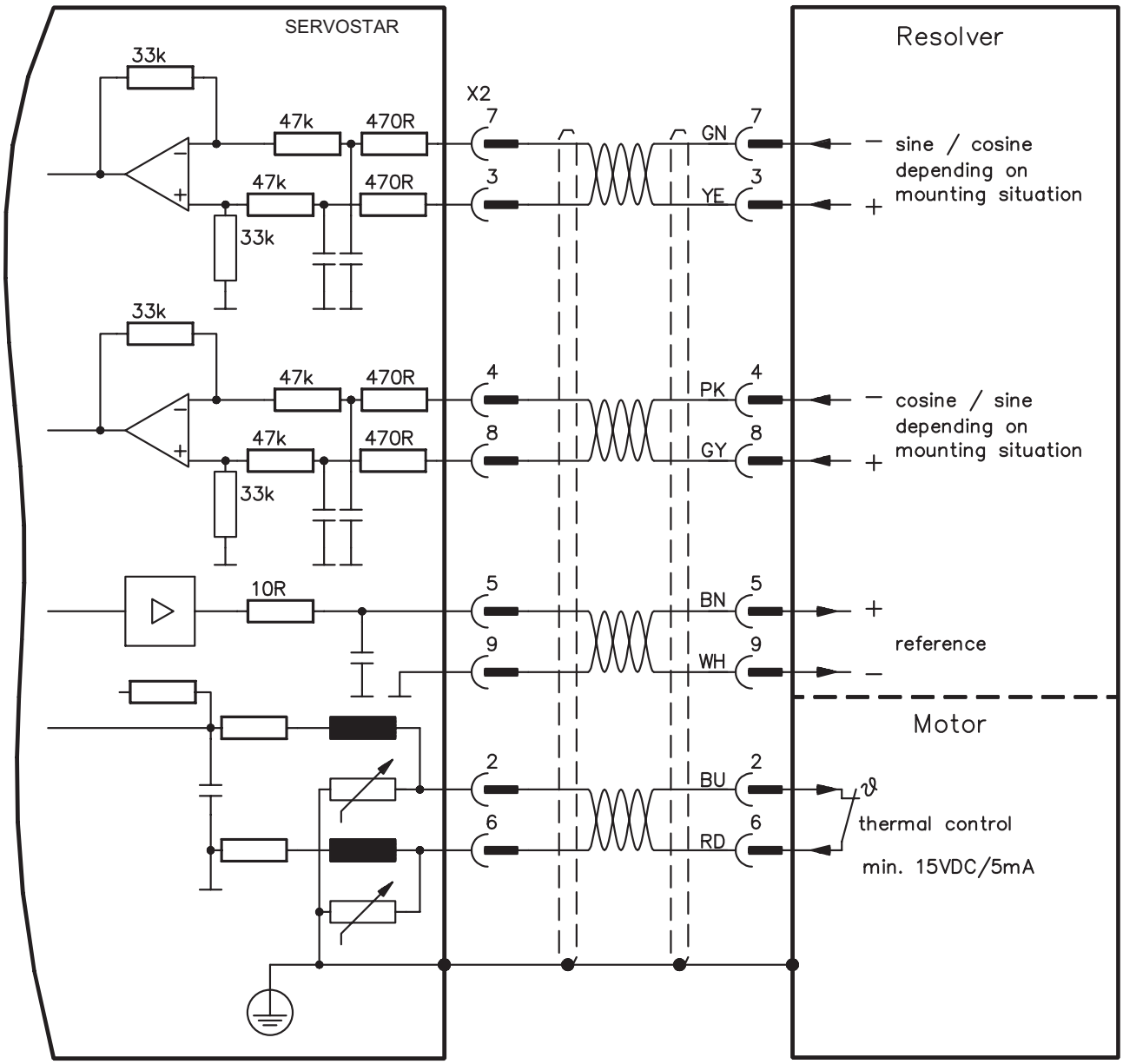
— Fusing and regen resistor provided by the user



III.4 Feedback

III.4.1 Resolver connection (X2)

Our rotatory servomotors have 2-pole hollow-shaft resolvers built in as a standard. It is possible to connect 2...36-pole resolvers to the SERVOSTAR 640/670.
If lead lengths of more than 100m are planned, please contact our customer service .
The thermostat contact in the motor is connected via the resolver cable to the SERVOSTAR 640/670 and evaluated there.



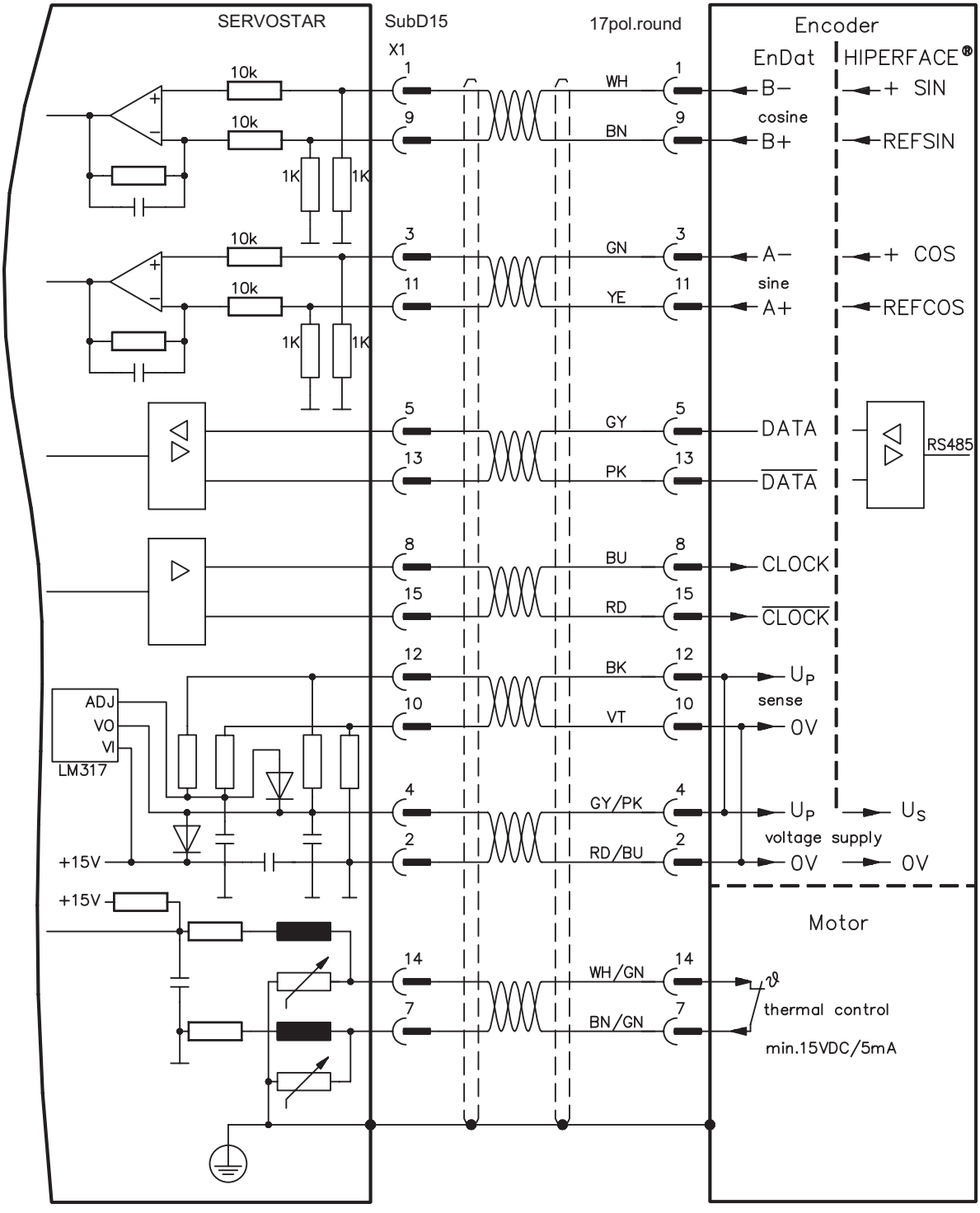
colors for European cables only

III.4.2 Encoder (X1)

As an option, our servomotors can be fit with a single-turn or multiturn sine-cosine encoder. Preferred types are ECN1313 and EQN1325.
This encoder is used by the SERVOSTAR 640/670 as a feedback device for drive tasks which require highly precise positioning or extremely smooth running.

If lead lengths of more than 50m are planned, please consult our customer service .

The thermostat contact in the motor is connected via the resolver cable to the SERVOSTAR 640/670 and evaluated there.
Max. input frequency: 250KHz



colors for European cables only

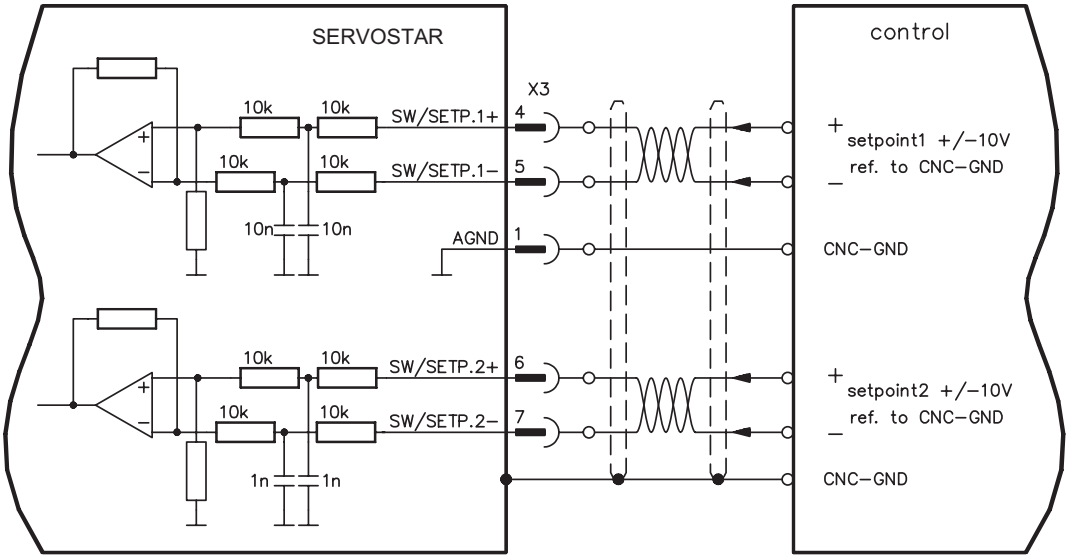
III.5 Control signals, monitor signals

III.5.1 Analog setpoint inputs (X3)

The servo amplifier is equipped with two differential inputs for analog setpoints which are **programmable**. AGND (X3/1) must always be joined to the CNC-GND of the controls as a ground reference.

Technical characteristics

— Differential-input voltage max. ± 10 V
— Resolution 1.25 mV
— Ground reference : AGND, terminal X3/1
— Input resistance 20 kΩ
— Common-mode voltage range for both inputs ± 10 V



Input SW/SETP.1 (terminals X3/4-5)
Differential input voltage max. ± 10 V, resolution 14-bit, scalable
Standard setting : speed setpoint

Input SW/SETP.2 (terminals X3/6-7)
Differential input voltage max. ± 10 V, resolution 12-bit, scalable
Standard setting : torque setpoint

Application examples for setpoint input SW/SETP.2:
— adjustable external current limit
— reduced-sensitivity input for setting-up/jog operation
— pre-control / override

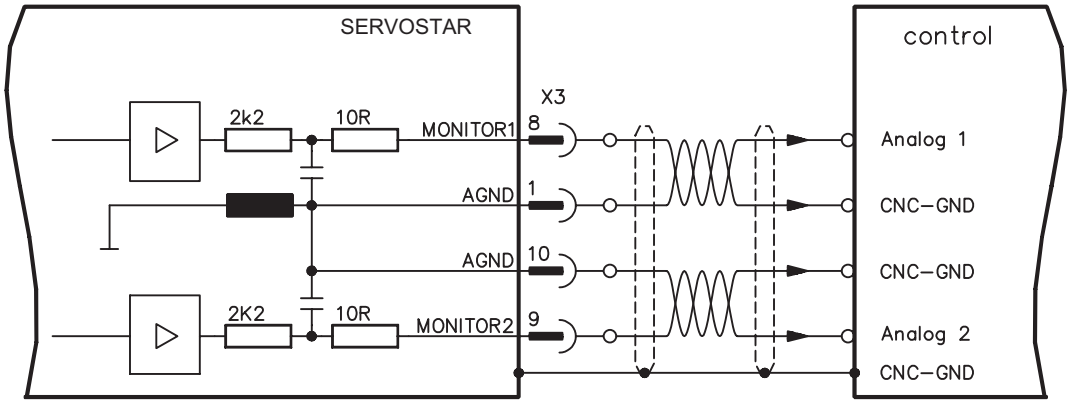
Fixing the direction of rotation
Standard setting : clockwise rotation of the motor shaft (looking at the shaft end)
— Positive voltage between terminal X3/4 (+) and terminal X3/5 (-) or
— Positive voltage between terminal X3/6 (+) and terminal X3/7 (-)

To reverse the direction of rotation, swap the connections to terminals X3/4-5 and. X3/6-7 or change the ROT. DIRECTION parameter in the “Speed controller” screen.

III.5.2 Monitor outputs (X3)

Technical characteristics

— Reference ground is analog-GND (AGND, terminal X3/1 and X3/10)
— Output resistance : 2.2kΩ
— Output voltage ±10V
— Resolution : 10 bit.



Programmable analog outputs MONITOR 1 / MONITOR 2

The terminals X3/8 (MONITOR 1) or X3/9 (MONITOR 2) can have the following analog signals assigned to them:

Standard setting :

Monitor 1 : Tachometer voltage **VTA** (speed)
The output delivers ±10V at the preset limit speed.

Monitor 2 : Current setpoint **IDC** (torque)
The IDC-monitor delivers ± 10V at the preset peak current (effective r.m.s. value).

You can use the terminals X3/8 (MONITOR 1) or X3/9 (MONITOR 2) to output converted analog values for digital measurements which are contained in the servo amplifier.

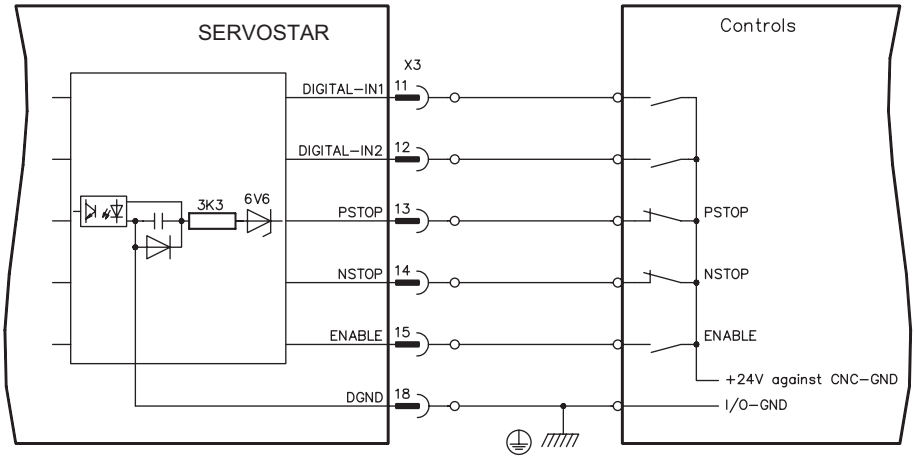
You can find a list of pre-programmed functions on the "analog I/O" screen of our setup software.

III.5.3 Digital control inputs (X3)

All digital inputs are **electrically isolated** through optocouplers.

Technical characteristics

— Reference ground is **digital**-GND (DGND, terminal X3/18)
— The logic is dimensioned for +24V / 7mA (**PLC-compatible**)
— H-level of +12 .. 36V / 7mA, L-level of 0 .. 7V / 0 mA



ENABLE input

The output stage of the servo amplifier is activated by the enable signal (terminal X3/15, input 24V, **active-high**).
In the inhibited state (low signal) the motor which is attached does not have any torque.

Programmable digital inputs :

You can use the digital inputs PSTOP / NSTOP / DIGITAL-IN1 and DIGITAL-IN2 to initiate preprogrammed functions that are stored in the servo amplifier.
You can find a list of pre-programmed functions on the "digital I/O" screen of our setup software.
If an input is freshly assigned to a pre-programmed function, then the data set must be stored in the EEPROM of the servo amplifier, and the 24V auxiliary supply of the servo amplifier must be switched off and on again (to reset the amplifier software).

Limit-switches PSTOP / NSTOP

Terminals X3/13 and X3/14 are normally programmed for the connection of limit switches. If these inputs are not needed for the connection of limit switches, then they are programmable for other input functions.

Limit-switch positive/negative (**PSTOP / NSTOP**, terminals X3/13 and X3/14), high level in normal operation (fail-safe for a cable break).

A low signal (open) inhibits the corresponding direction of rotation, **the ramp function remains effective.**

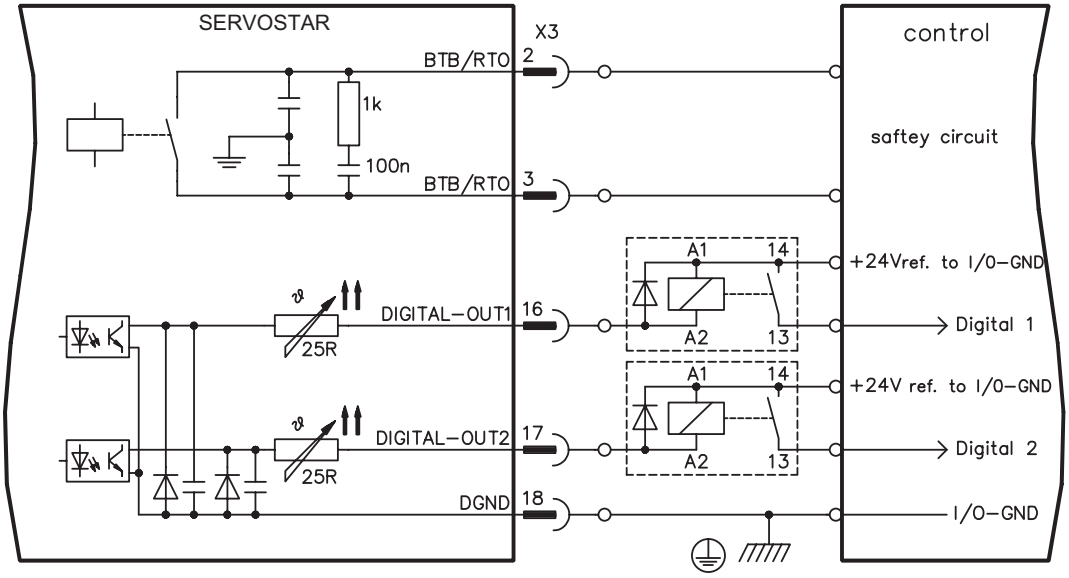
DIGITAL-IN 1 / DIGITAL-IN 2

The digital inputs on terminals X3/11 (DIGITAL-IN 1) or terminal X3/12 (DIGITAL-IN 2) can be logically combined in a pre-programmable function.

III.5.4 Digital control outputs (X3)

Technical characteristics

— Reference ground is digital-GND (DGND, terminal X3/18)
— All digital outputs are floating
— DIGITAL-OUT1 and 2 : Open-collector, max. 30VDC, 10 mA
BTB/RTO : Relay output, max. 30VDC or 42VAC, 0.5A



Ready-to-operate contact BTB/RTO

Operational readiness (terminals X3/2 and X3/3) is signalled by a **floating** relay contact.
The contact is **closed** when the servo amplifier is ready for operation, the signal is **not** influenced by the enable signal, the I²t- limit, or the regen threshold.

All faults cause the BTB/RTO contact to open and the switch-off of the output stage.
A list of the error messages can be found on page 62.

Programmable digital outputs DIGITAL-OUT 1 / 2:

You can use the digital outputs DIGITAL-OUT1 (terminal X3/16) and DIGITAL-OUT2 (terminal X3/17) to outputs messages from pre-programmed functions that are stored in the servo amplifier. You can find a list of pre-programmed functions on the "digital I/O" screen of our setup software.

If an input is freshly assigned to a pre-programmed function, then the data set must be stored in the EEPROM of the servo amplifier, and the 24V auxiliary supply of the servo amplifier must be switched off and on again (to reset the amplifier software).

Evaluate the outputs via inverting interface relays (see connection diagram), for example Phönix DEK-REL-24/I/1 (turn-on delay 6 ms, turn-off delay 16ms).

The described logic in the SETUP SOFTWARE manual refers to the output of the inverting interface relays. Consider the delay of the applied relay !

III.6 Encoder simulations

III.6.1 Incremental encoder simulation - A quad B position output (X5)

The incremental-encoder interface is part of the package supplied. Select the encoder function ROD (screen page “Encoder”). In the servo amplifier, the position of the motor shaft is calculated from the cyclic-absolute signals of the resolver or encoder. Incremental-encoder compatible pulses are generated from this information. Pulses are output on the SubD-connector X5 as two signals, A and B, with 90° phase difference and a zero pulse.

The resolution (lines before quadrature) can be changed with the RESOLUTION parameter:

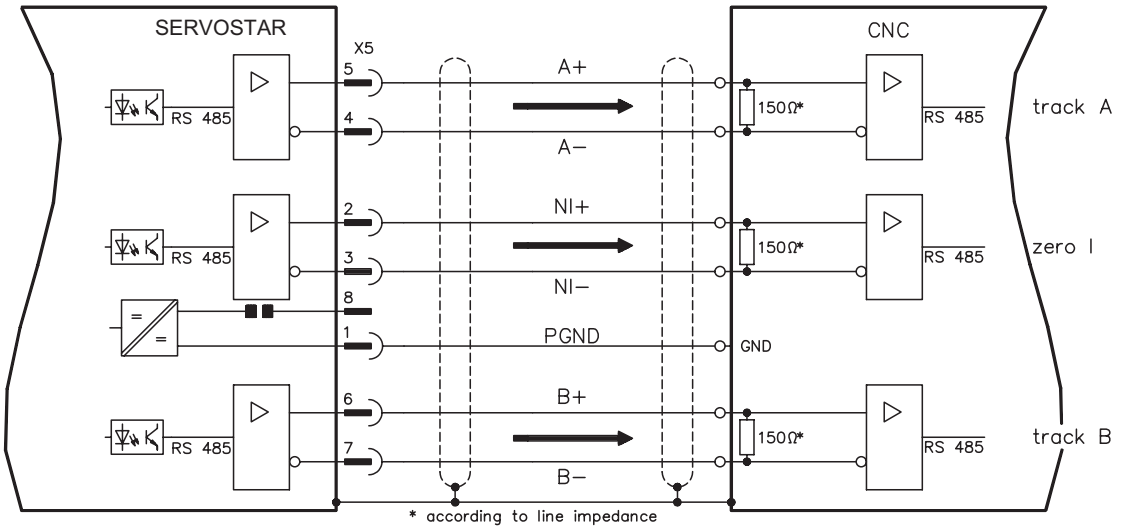
Encoder function (ENCMODE)	Feedback system	Resolution	Zero position
ROD (1)	Resolver	16...1024	one per revolution (only if A=B=1)
	EnDat / HIPERFACE	16...4096 and 8192...524288 (2^n)	one per revolution (only if A=B=1)
ROD interpolation (3)	Incremental encoders without absolut data channel	4...128 (2^n) TTL lines per sine line	analog pass through from X1 to X5

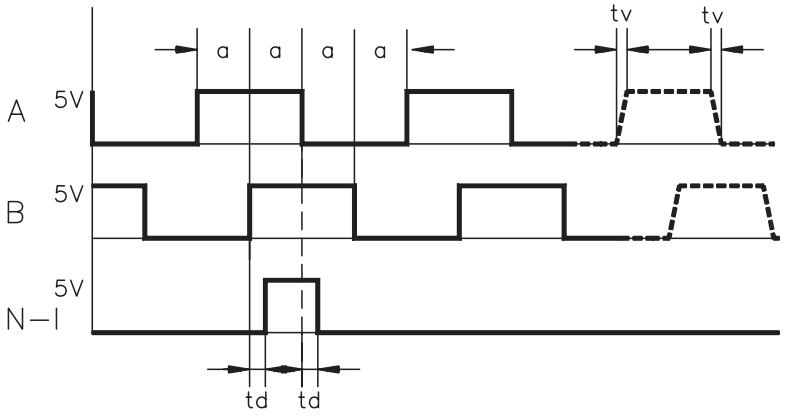
You can also adjust and store the position of the zero pulse within one mechanical turn (parameter NI-OFFSET).

The drivers are supplied from an internal supply voltage.
PGND must always be connected to the controls.

The max. admissible cable length is 10 m.

Connections and signal description for incremental-encoder interface :





Edge spacing a ≥ 0,20 µs
Edge steepness tv ≤ 0.1 µs
Delay N–I–td ≤ 0.1 µs
I∆UI ≥ 2V/20mA

III.6.2 SSI encoder simulation - position output (X5)

The SSI interface (synchronous serial absolute-encoder simulation) is part of the delivered package. Select the encoder function SSI (screen page “Encoder”). In the servo amplifier, the position of the motor shaft is calculated from the cyclically absolute signals from the resolver or encoder. This information is used to create a position output in a format that is compatible with the standard SSI-absolute-encoder format. 24 bits are transmitted.
SINGLE TURN selected: The upper 12 or 9 bits are fixed to ZERO, the lower 12 or 15 bits contain the position information. For 2-pole resolvers, the position value refers to the position within one turn of the motor, for 4-pole resolvers it is within half a turn, and for 6-pole resolvers it is within a third of a turn. Exception: If an encoder with a commutation track is used as the feedback unit, then the upper 12 bits are set to 1 (data invalid!) until a homing run is performed.

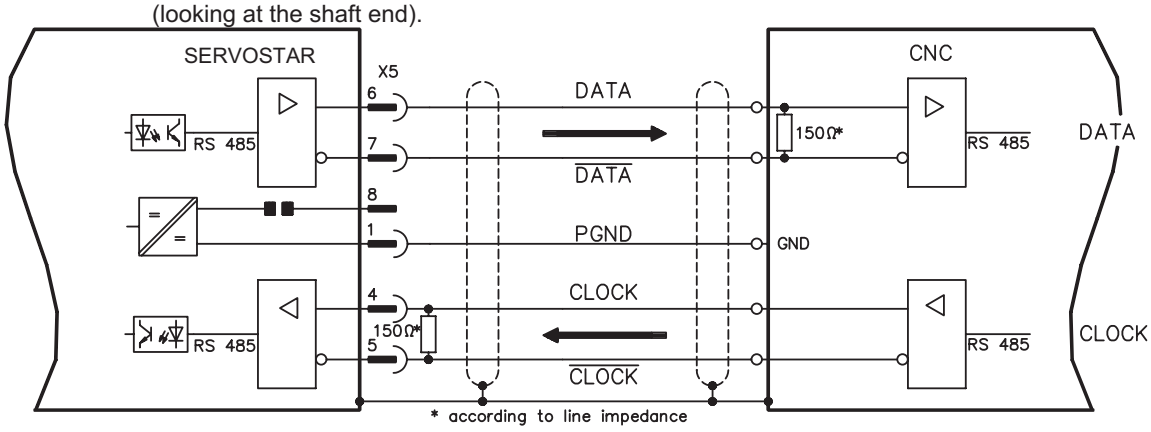
MULTI TURN selected: The upper 12 or 9 bits contain the number of motor turns, the lower 12 or 15 bits contain the position information.

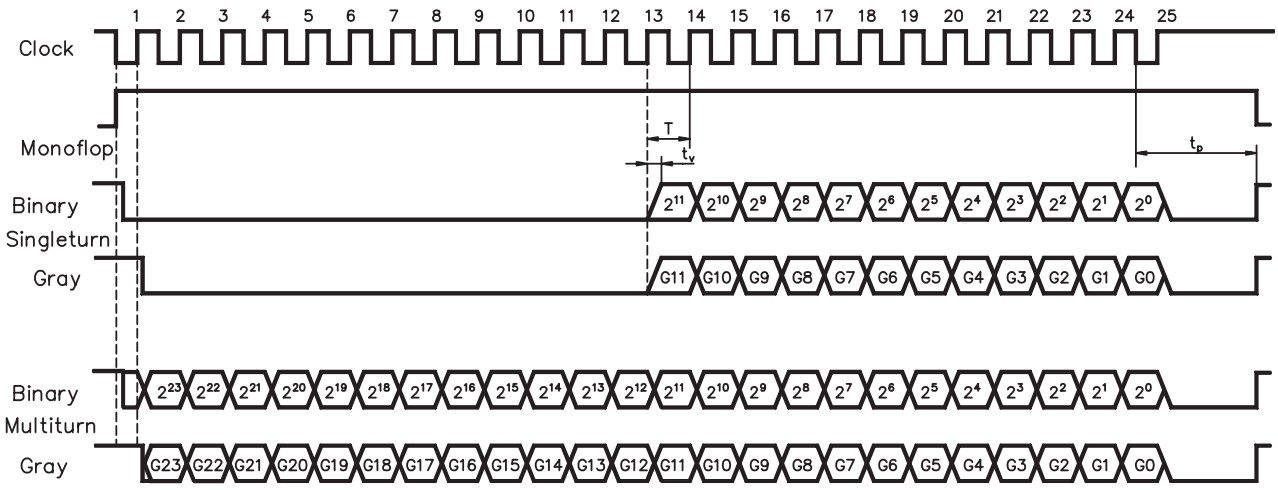
The signal sequence can be output in **Gray** code (standard) or in **binary** code (parameter SSI-CODE). The servo amplifier can be adjusted to the clock frequency of your SSI-evaluation with the SSI-TAKT parameter (**200 kHz or 1.5MHz and inverted**).

Drivers are supplied from internal supply voltage. **PGND must always be connected.**

Connection and signal description for SSI interface :

The count direction for the SSI interface is upwards when the motor shaft is rotating clockwise (looking at the shaft end).





Transfer bit rate	Monoflop stabilize time
200 KBaud	$t_p \approx 13\mu s$
1,5 MBaud	$t_p \approx 3\mu s$

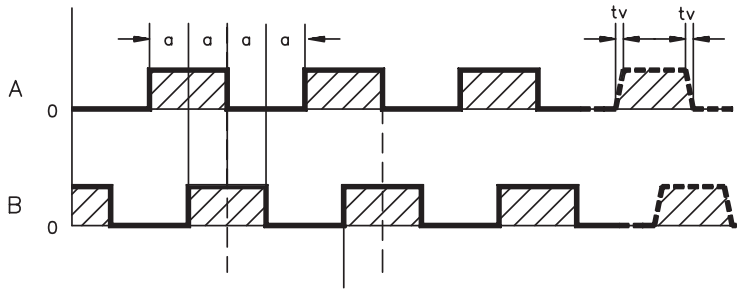
Switch over time Data $t_v \leq 300$nsec
Period T = 600 ns

Output IΔUI ≥ 2V/20mA
Input IΔUI ≥ 0,3V

III.6.3 Interface for master-slave operation, encoder input

This interface can be used to link several SERVOSTAR 640/670 amplifiers together in master-slave operation.
The parameters for the slave amplifiers are set up with the aid of the setup software.
The resolution (no. of pulses/turn) can be adjusted. The analog setpoint inputs are out of action.
AGND and DGND (connector X3) must be joined together !

Signal diagram (for encoders with RS422 or 24V output)

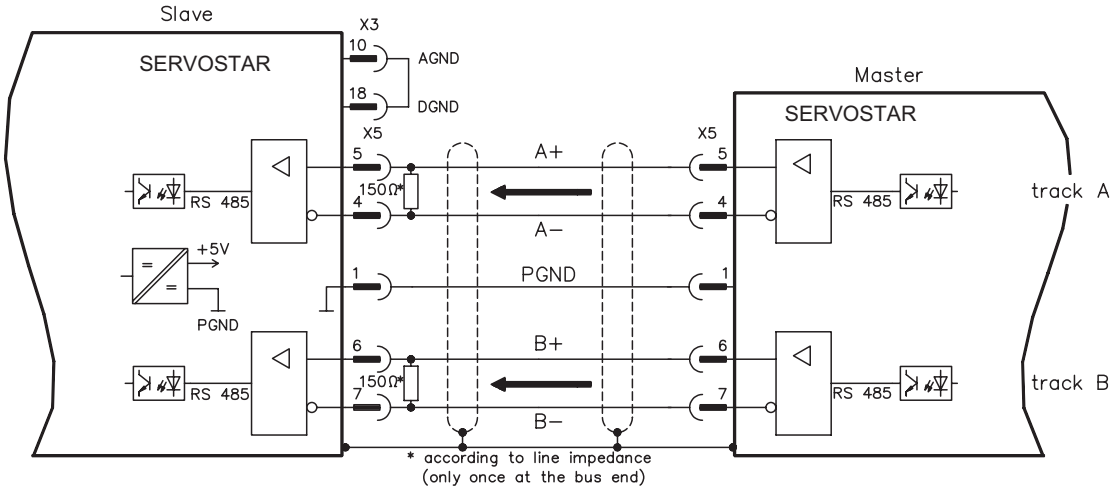


III.6.3.1 Connection to a SERVOSTAR master, 5V signal level (X5)

This interface can be used to link several SERVOSTAR amplifiers together in master-slave operation. Up to 16 slave amplifiers can be controlled by the master via the encoder output. The connector X5 must be used.

Edge frequency: 1,5MHz, slew rate tv ≤ 0,1µs

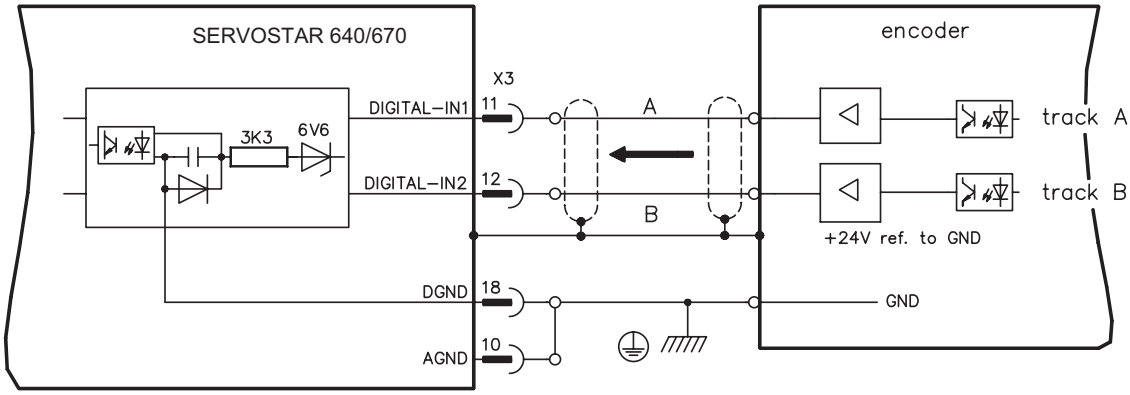
AGND and DGND (connector X3) must be joined together !



III.6.3.2 Connection to encoders with 24V signal level (X3)

This interface can be used to operate the SERVOSTAR 640/670 as a slave, mastered by an encoder with 24V signal level (master-slave operation). The digital inputs DIGITAL-IN 1 and 2 at connector X3 must be used.

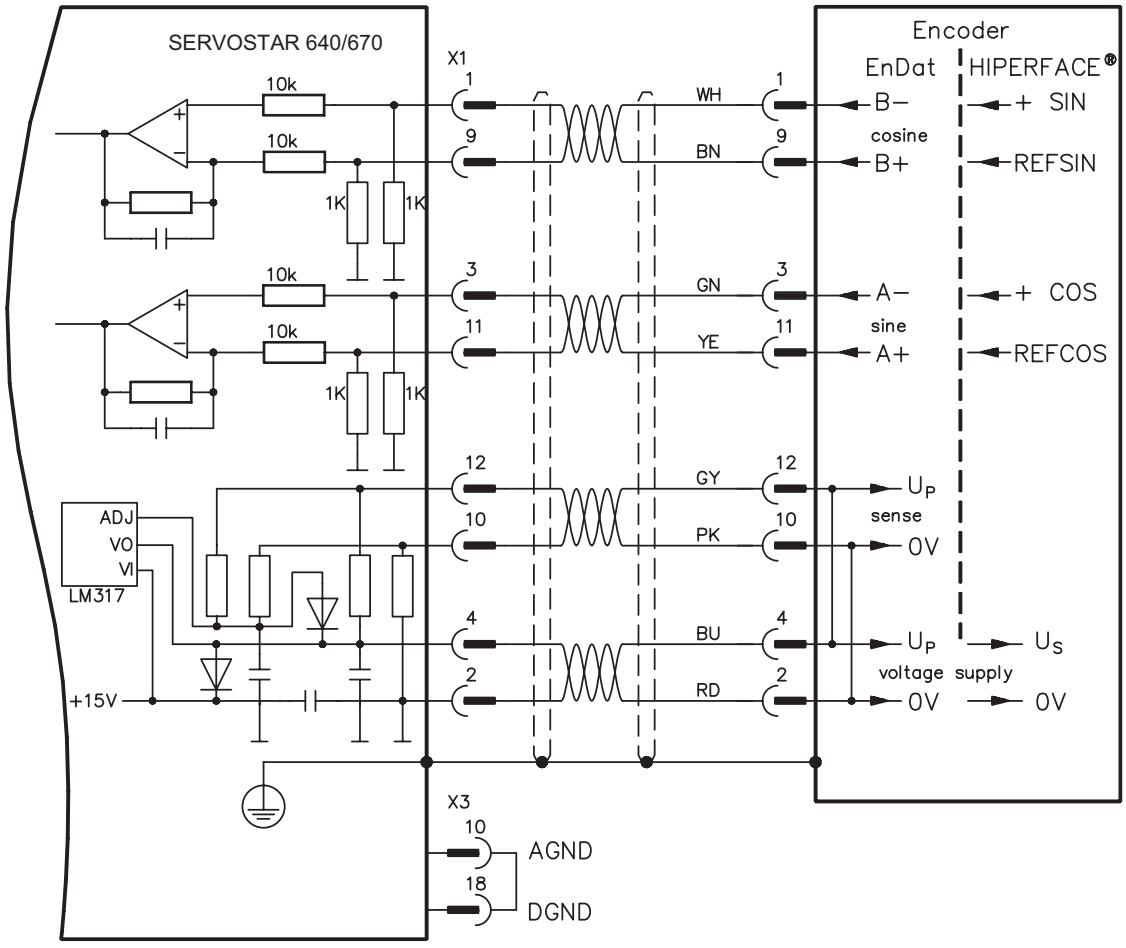
Edge frequency: 250 kHz, slew rate tv ≤ 0,1µs
AGND and DGND (connector X3) must be joined together !



III.6.3.3 Connection to a sine-cosine encoder (X1)

This interface can be used to operate the SERVOSTAR 640/670 as a slave, mastered by a sine-cosine encoder (master-slave operation). The connector X1 must be used.
Edge frequency: 100 kHz

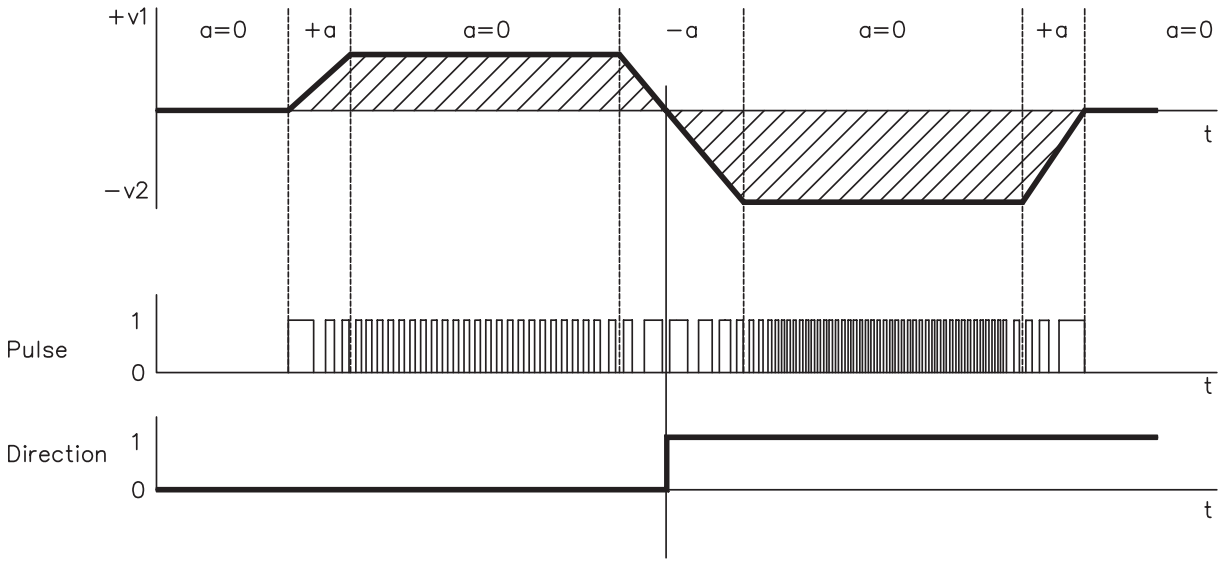
AGND and DGND (connector X3) must be joined together !
The cable colors in the wiring diagram are valid for the european 4x2x0,25mm² cable.



III.7 Interface for stepper-motor controls (pulse-direction)

This interface can be used to connect the servo amplifier to a third-party stepper-motor controller. The parameters for the servo amplifier are set up with the aid of the setup software (electrical gearing). The number of steps can be adjusted, so that the servo amplifier can be adjusted to the pulse-direction signals of any stepper-motor controller. Various monitoring signals can be output. The analog setpoint inputs are out of action.
AGND and DGND (connector X3) must be joined together !

Speed profile and signal diagram



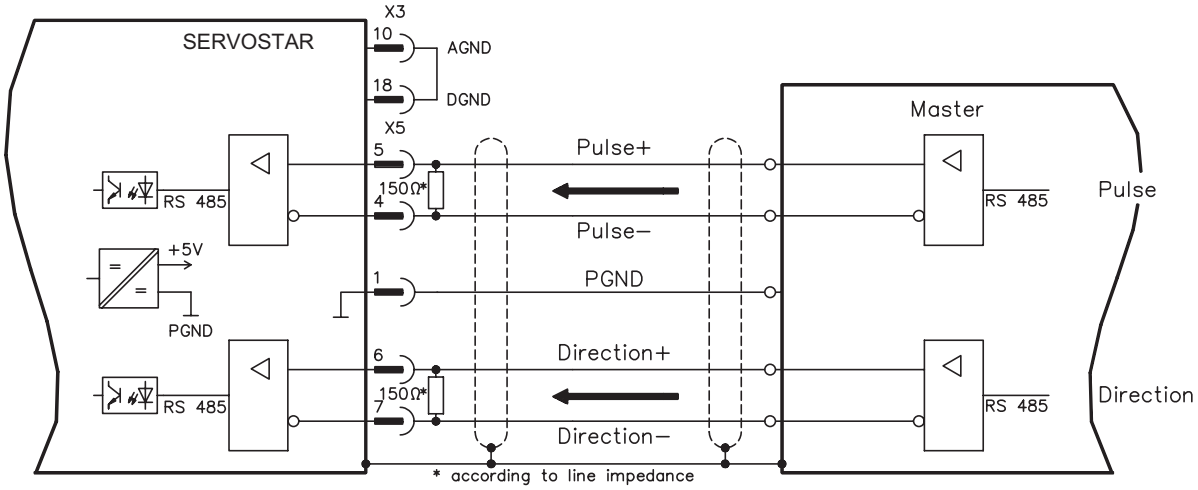
Equivalences
path traversed s —— number of pulses
velocity v —— pulse frequency
acceleration a —— rate of change of pulse frequency

Note:
Encoder Input A quad B offers more EMI supression.

III.7.1 Connection to stepper-motor controller with 5V signal level (X5)

This interface can be used to connect the servo amplifier to a stepper-motor controller with 5V signal level. The connector X5 must be used.
Edge frequency: 1,5MHz

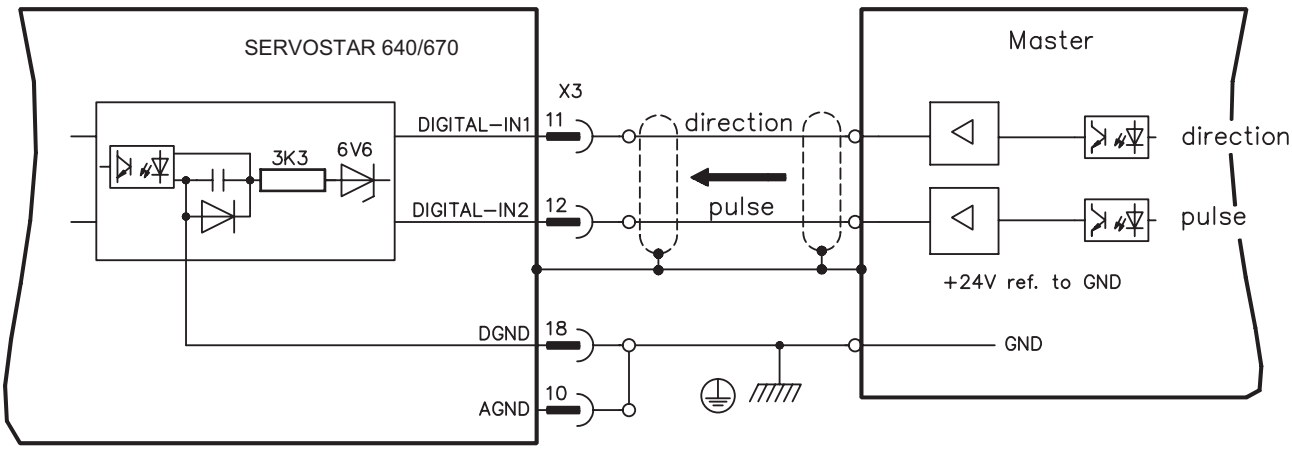
AGND and DGND (connector X3) must be joined together !



III.7.2 Connection to stepper-motor controller with 24V signal level (X3)

This interface can be used to connect the servo amplifier to a stepper-motor controller with 24V signal level. The digital inputs DIGITAL-IN 1 and 2 at connector X3 must be used.
Edge frequency: 100 kHz

AGND and DGND (connector X3) must be joined together !



III.8 RS232 interface, PC connection (X6)

The setting of the operating, position control, and motion-block parameters, can be carried out on an ordinary commercial PC.

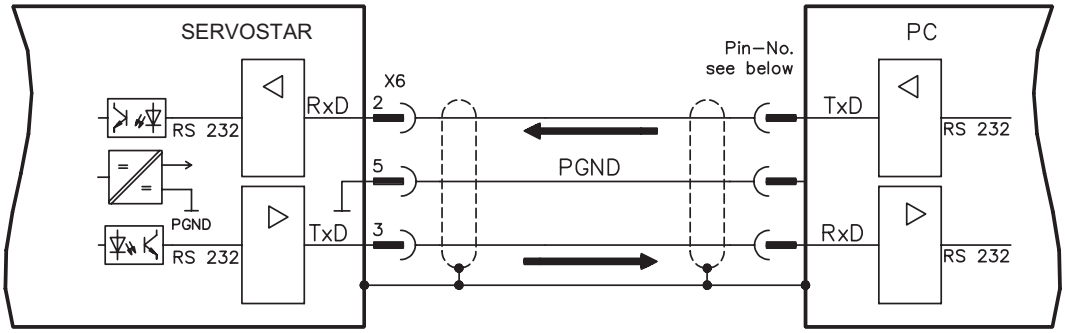
Connect the PC interface (X6) of the servo amplifier **while the supply to the equipment is switched off** via a normal commercial 3-core null-modem cable to a serial interface on the PC.

Do not use a null-modem link cable!

The interface is electrically isolated through an optocoupler, and is at the same potential as the CANopen interface.

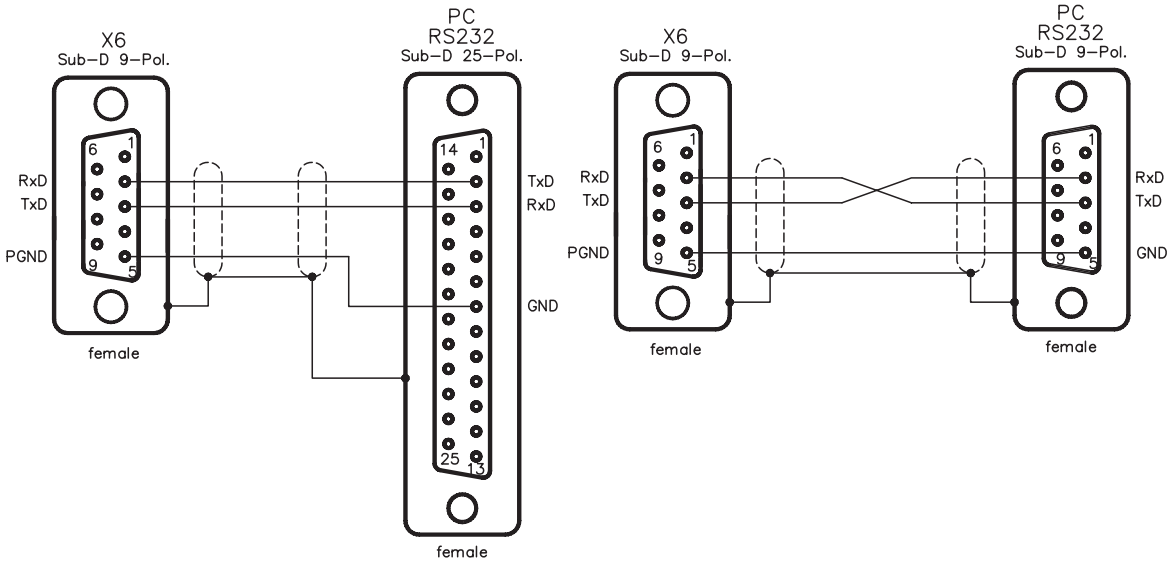
The interface is selected and set up in the setup software.
Further notes can be found on page 37.

With the optional expansion card -2CAN- the two interfaces for RS232 and CAN, which otherwise use the same connector X6, are separated onto two connectors (⇨ p. 73).



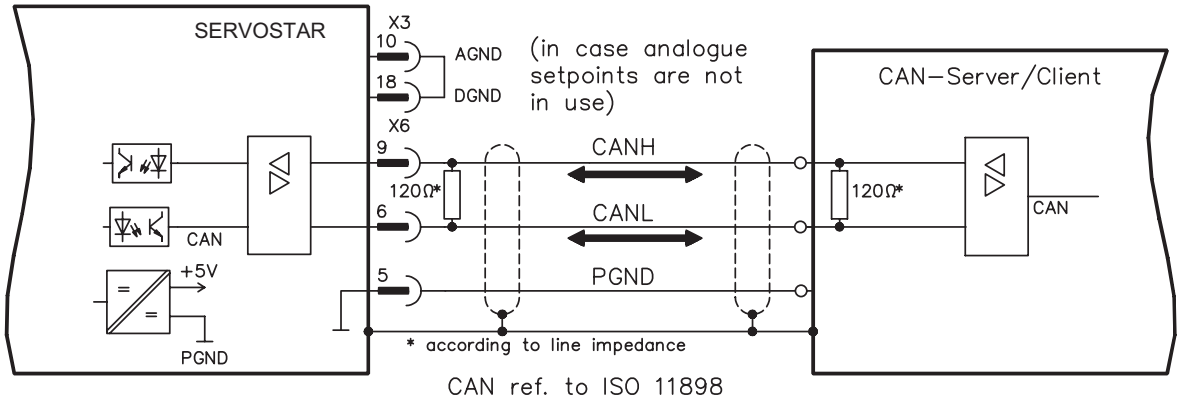
Interface cable between the PC and servo amplifiers of the SERVOSTAR 640/670 series:

(View : looking at the face of the built-in SubD connectors, this corresponds to the solder side of the SubD sockets on the cable)



III.9 CANopen Interface (X6)

The interface for connection to the CAN bus (default 500 kBaud). The integrated profile is based on the communication profile CANopen DS301 and the drive profile DSP402. The following functions are available in connection with the integrated position controller:
Jogging with variable speed, reference traverse (zeroing), start motion task, start direct task, digital setpoint provision, data transmission functions and many others.
Detailed information can be found in the CANopen manual. The interface is electrically isolated by optocouplers, and is at the same potential as the RS232 interface. The analog setpoint inputs can still be used.
With the optional expansion card -2CAN- the two interfaces for RS232 and CAN, which otherwise use the same connector X6, are separated onto two connectors (⇨ p. 73).
If the analog setpoint inputs are not used, then AGND and DGND (connector X3) must be joined together !



CAN ref. to ISO 11898

CAN bus cable

To meet ISO 11898 you should use a bus cable with a characteristic impedance of 120 Ω. The maximum usable cable length for reliable communication decreases with increasing transmission speed. As a guide, you can use the following values which we have measured, but they are not to be taken as assured limits:

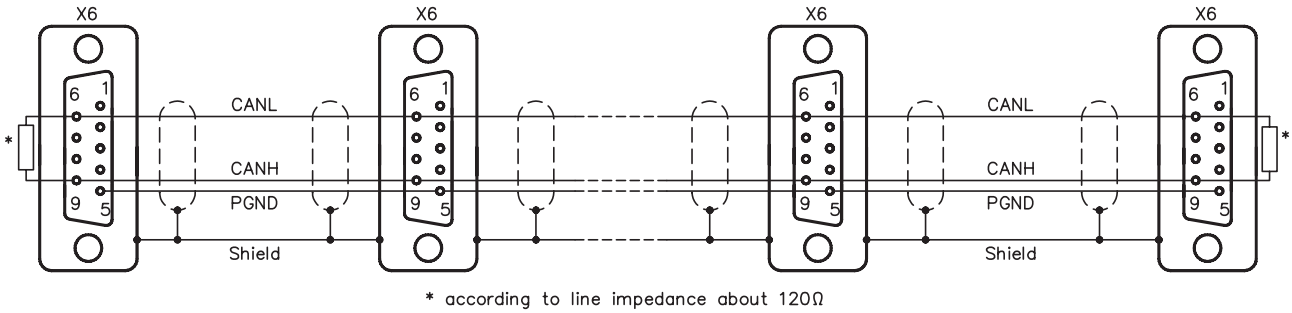
Cable data:	Characteristic impedance	100-120 Ω
	Cable capacity	max. 60 nF/km
	Lead resistance (loop)	159.8 Ω/km

Cable length, depending on the transmission rate

Transmission rate / kbaud	max. cable length / m
1000	20
500	70
250	115

Lower cable capacity (max. 30 nF/km) and lower lead resistance
(loop, 115 Ω/km) make it possible to achieve greater distances.
(Characteristic impedance 150 ± 5Ω ⇒ terminating resistor 150 ± 5Ω).
For EMC reasons, the SubD connector housing must fulfil the following conditions:

— metal or metallized housing
— provision for cable shielding connection in housing, large-area connection



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IV Setup

IV.1 Important notes

Only professional personnel with extensive knowledge in the fields of electrical/ drive technology are allowed to setup the servo amplifier.

The setup procedure is described as an example. Depending on the application, a different procedure may be sensible or necessary.

In multi-axis systems, setup each servo amplifier individually.

The manufacturer of the machine must generate a hazard analysis for the machine, and take appropriate measures to ensure that unforeseen movements cannot cause injury or damage to any person or property.

Caution !
Check that all live connecting elements are protected from accidental contact.
Deadly voltages can be present, up to 900V.
Never disconnect any of the electrical connections to the servo amplifier while it is live.
Capacitors can still have residual charges with dangerous levels up to 300 seconds after switching off the supply power.
Heat sinks of the amplifier can reach a temperature of up to 80°C (176°F) in operation. Check (measure) the heat sink temperature. Wait until the heat sink has cooled down below 40°C (104°F) before touching it.

Warning !
If the servo amplifier has been stored for longer than 1 year, then the DC-link capacitors will have to be re-formed.
To do this, disconnect all the electrical connections.
Supply the servo amplifier for about 30 min. from single-phase 230VAC to the terminals L1 / L2. This will re-form the capacitors.

Further setup information:
The adaptation of parameters and the effects on the control loop behavior are described in the online help.
The setup of the expansion card (if present) is described in the corresponding manual on the CD-ROM.
We can provide further know-how through training courses (on request).

The following instructions should help you to carry out the setup in a sensible order, without any hazards to people or machinery.

Check installation	⇨ p.27ff. **Disconnect the servo amplifier from the supply.**
Inhibit Enable signal	0V on terminal X3/15 (Enable)
Switch on 24V auxiliary voltage	24VDC on terminal X4/1, ground on terminal X4/3 After the initialisation procedure (about 0.5 sec.) the status is shown in the LED display (⇨ p.61)
Switch on PC, start setup software	Select the interface to which the servo amplifier is connected, The parameters which are stored in the SRAM of the servo amplifier are transferred to the PC.
Check displayed parameters, and correct if necessary	***Caution !*** ***It is especially important to check the following parameters. If you do not keep to them, parts of the system can be damaged or destroyed.***

Supply voltage	: set to the actual mains supply voltage
Rated motor voltage	: at least as high as the DC-link voltage of the amplifier
Motor pole-no.	: must match the motor (see motor manual)
Feedback	: must match the feedback unit in the motor
I_{RMS}	: maximum is the motor standstill current I_0 (on nameplate)
I_{PEAK}	: maximum is 4 x motor standstill current I_0
Limit speed	: maximum is the rated motor speed (on nameplate)
Regen power	: maximum is the permitted regen resistor dissipation
Station address	: unique address (see setup software manual)

Check safety devices	***Caution !*** ***Make sure that any unintended movement of the drive cannot cause danger to machinery or personnel.***
Switch on supply power	through the ON/OFF button of the contactor control
Apply 0V setpoint	0V on terminals X3/4-5 or X3/6-7
Enable	(500 ms after switching on the supply power) 24VDC on terminal X3/15, motor stands with standstill torque M_0
Setpoint	apply a small analog setpoint, about 0.5V is recommended, to terminals X3/4-5 or X3/6-7 **If the motor oscillates, the parameter Kp in the menu page "speed controller" must be reduced - the motor is endangered!**
Optimization	Optimize speed, current and position controllers
Setup the expansion card	see setup instructions in the corresponding manual on the CD-ROM

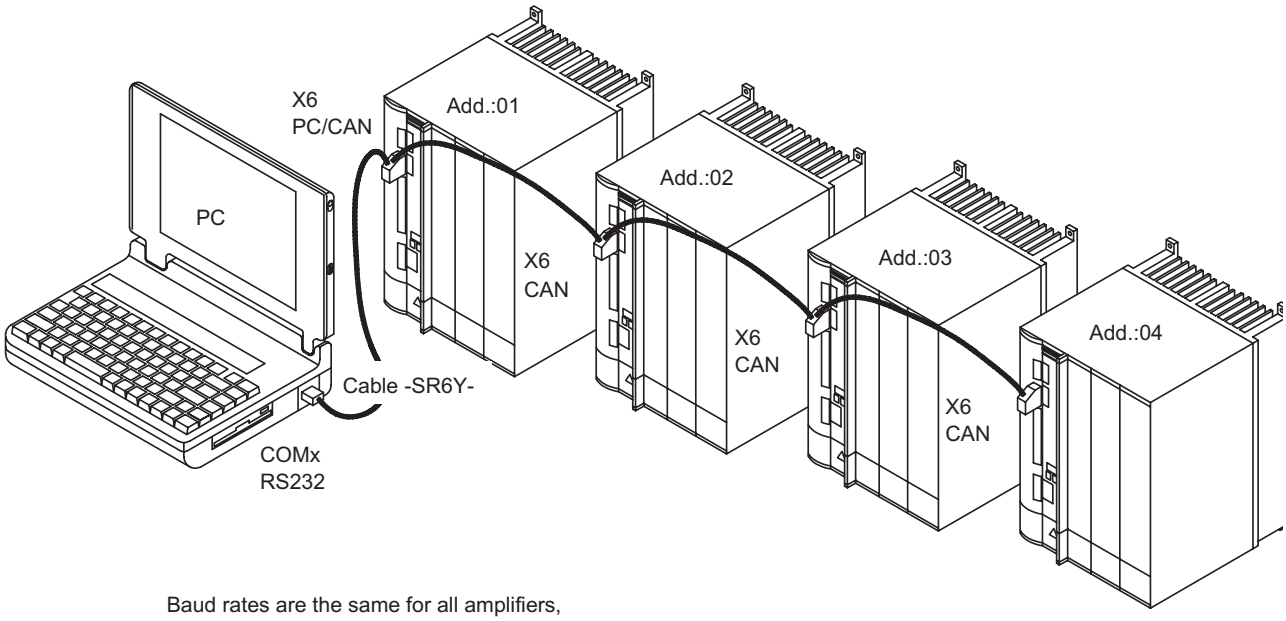
IV.2 Parameter setting

A default parameter set is loaded into your servo amplifier by the manufacturer. This contains valid and safe parameters for the current and speed controllers.
A database for motor parameters is stored in the servo amplifier. During setup you must select the data set for the motor that is connected and store it in the servo amplifier. For most applications these settings will already provide good to very good control loop characteristics.
An exact description of all parameters and the possibilities for optimizing the control loop characteristics can be found in the manual “Setup Software DRIVE.EXE”.

IV.2.1 Multi-axis systems

Using a special multilink cable, you can connect up to six servo amplifiers together and to your PC : Cable type -SR6Y- (for 4 amplifiers) or -SR6Y6- (for 6 amplifiers).

With the PC connected to just one servo amplifier you can now use the setup software to select all amplifiers through the preset station addresses and set up the parameters.



Baud rates are the same for all amplifiers,
see table below

IV.2.1.1 Node address for CAN-bus

During setup it makes sense to preset the station addresses for the individual amplifiers and the baud rate for communication by means of the keypad on the front panel (⇨ p. 61).

IV.2.1.2 Baud rate for CAN-bus

After changing the station address and baud rate you must turn the 24V auxiliary supply of the servo amplifier off and on again.

Coding of the baud rate in the LED display :

Coding	Baud rate in kbit/s	Coding	Baud rate in kbit/s
0	10	5	250
1	20	6	333
2	50	7	500
3	100	8	666
4	125	9	800
		10	1000

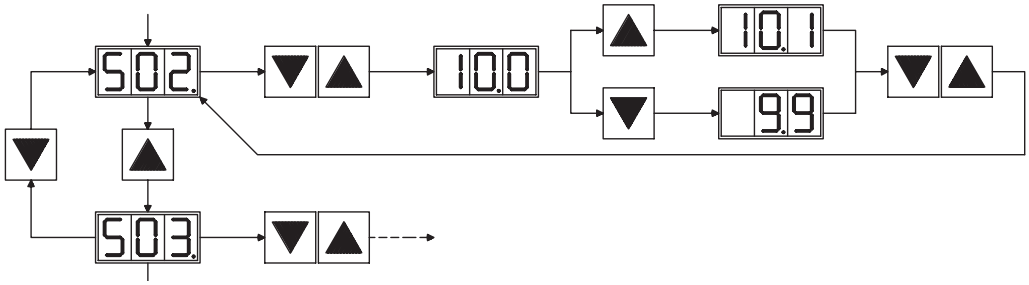
IV.2.2 Key operation / LED display

In this chapter the two possible operation menus and the use of the keys in the front panel are shown. Normally, the SERVOSTAR 640/670 only places the standard menu at your disposal. If you want to attend the amplifier via the detailed menu, you must keep the right key pressed while switching on the 24V-supply.

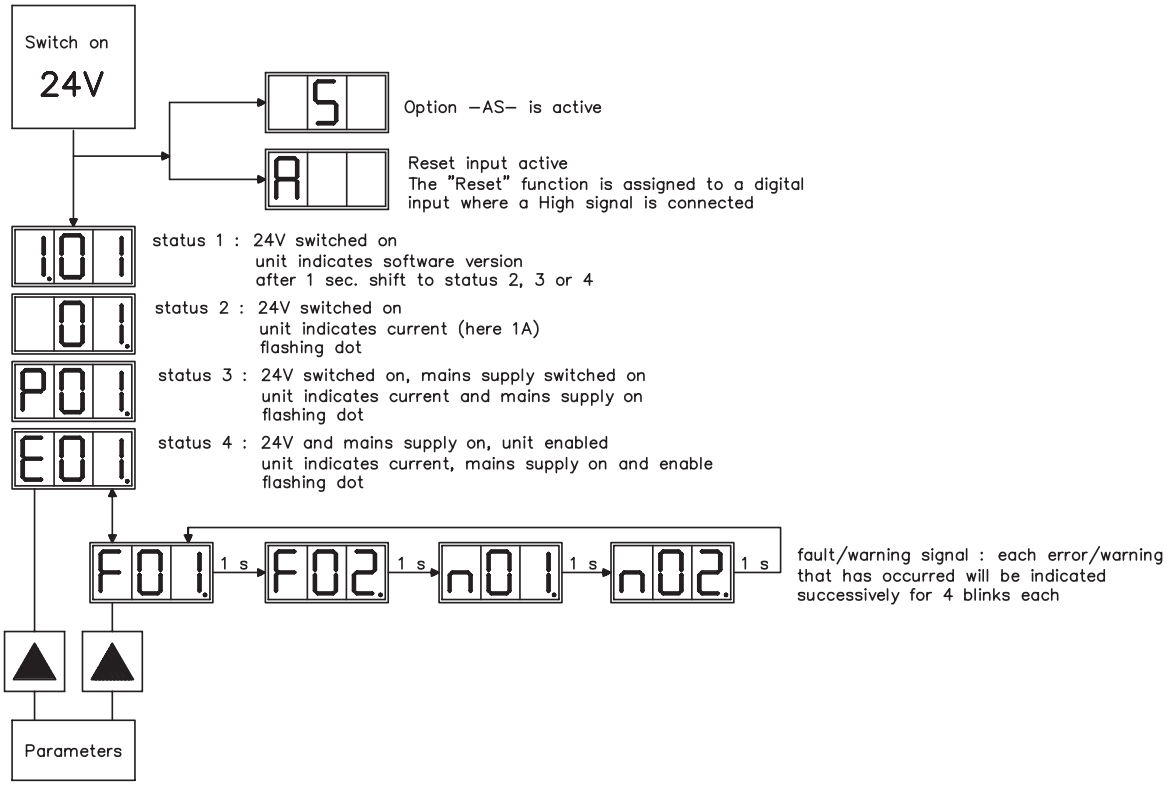
IV.2.2.1 Key operation

The two keys can be used to perform the following functions:

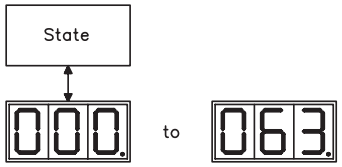
Key symbol	Functions
▲	**press once** : go up one menu item, increase number by one **press twice in rapid succession** : increase number by ten
▼	**press once** : go down one menu item, decrease number by one **press twice in rapid succession** : decrease number by ten
▲ ▼	**press and hold right key, then press left key as well :** enters a number, return function



IV.2.2.2 Status display

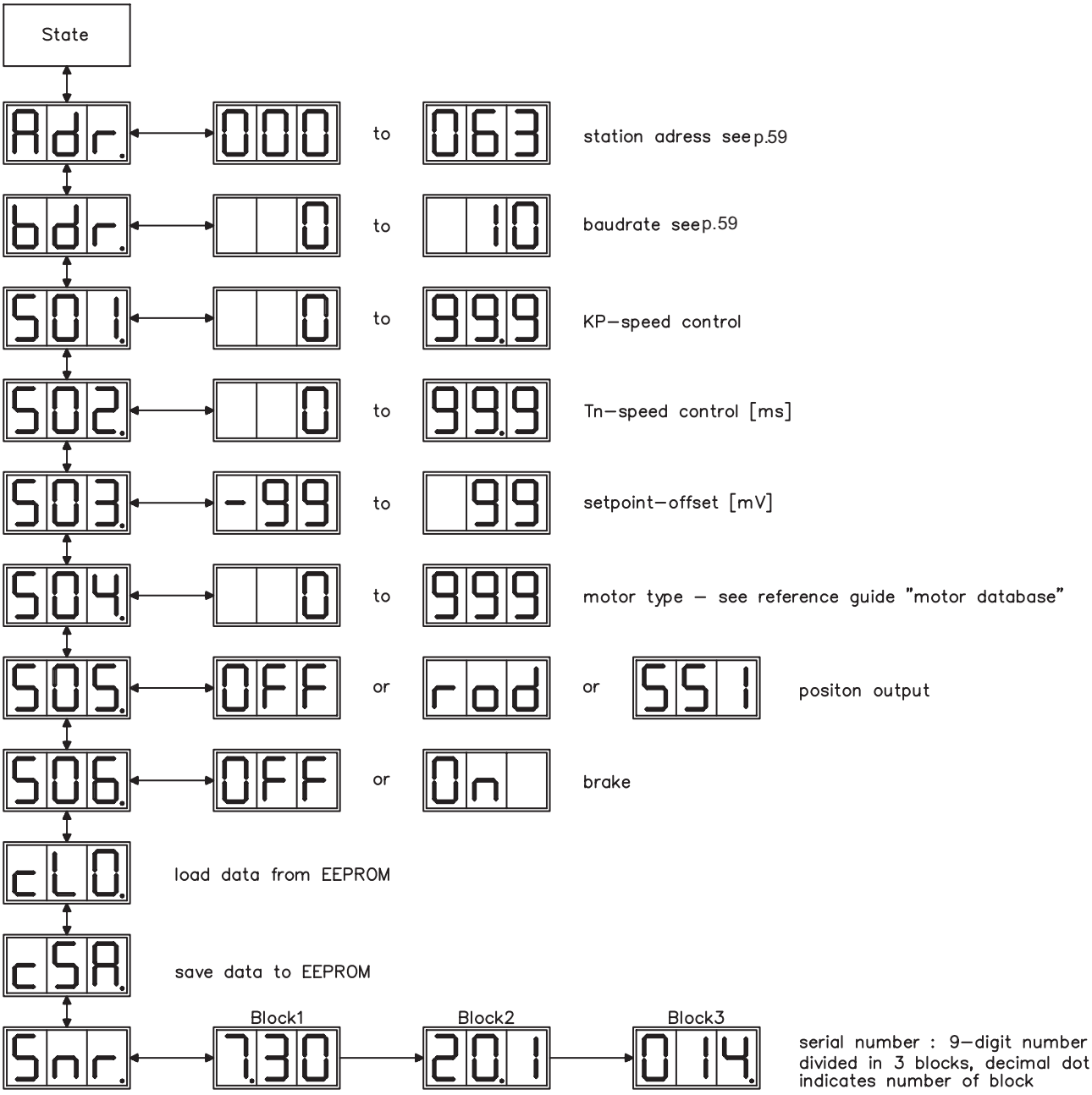


IV.2.2.3 Standard menu structure



station adress see p.59
the entry will be stored automatically, when you exit the input field.

IV.2.2.4 Extended menu structure



IV.3 Error messages

Errors which occur are shown in coded form by an error number in the LED display on the front panel. All error messages result in the BTB/RTO contact being opened, and the output stage of the amplifier being switched off (motor loses all torque). If a motor-holding brake is installed, it will be activated.

Number	Designation	Explanation
F01*	heat sink temperature	heat sink temperature too high limit is set by manufacturer to 80°C
F02*	overvoltage	overvoltage in DC-link limit depends on the mains supply voltage
F03*	following error	message from the position controller
F04	feedback	cable break, short circuit, short to ground
F05*	undervoltage	undervoltage in DC-link limit is set by manufacturer to 100V
F06	motor temperature	motor temperature too high limit is set by manufacturer to145°C
F07	aux. voltage	internal aux. voltage not OK
F08*	overspeed	motor running away, speed is too high
F09	EEPROM	checksum error
F10	Flash-EPROM	checksum error
F11	brake	cable break, short circuit, short to ground
F12	motor phase	motor phase missing (cable break or similar)
F13*	internal temperature	internal temperature too high
F14	output stage	fault in the output stage
F15	I²t max	I²t max. value exceeded
F16*	supply - BTB/RTO	2 or 3 phases missing in the supply feed
F17	A/D converter	error in the analog-digital conversion, usually caused by excessive EMI
F18	regen	regen circuit faulty or incorrect setting
F19	supply phase	a supply phase is missing (can be switched off for 2-phase operation)
F20	Slot fault	Hardware fault of the expansion card
F21	Handling fault	Software fault of the expansion card
F22	Short circuit to earth (ground)	short circuit to earth (ground)
F23	CAN Bus off	CAN Bus total communication error
F24	Warning	Warning displays as error
F25	Commutation error	Encoder systems only
F26	Limit switch	Homing error (hardware limit switch reached)
F27	restart lock -AS-	Operating error for restart lock -AS-
F28	reserved	reserved
F29	SERCOS error	SERCOS error
F30	Emerg. Stop Timeout	Emerg. Stop Timeout
F31	reserved	reserved
F32	system error	system software not responding correctly

* = These error messages can be cancelled by the ASCII command CLRFAULT, without executing a reset. If only these errors are present, and the RESET button or the I/O-function RESET is used, the CLRFAULT command is also all that is carried out.

IV.4 Warning messages

Faults which occur, but which do not cause a switch-off of the amplifier output stage (BTB/RTO contact remains closed) , are indicated in the LED display on the front panel by a coded warning number.

Number	Designation	Explanation
n01	I²t	I²t threshold exceeded
n02	regen power	preset regen power reached
n03*	S_fault	exceeded preset contouring error
n04*	response monitoring	response monitoring (fieldbus) is active
n05	supply phase	supply phase missing
n06*	Sw limit-switch 1	passed software limit-switch 1
n07*	Sw limit-switch 2	passed software limit-switch 2
n08	motion task error	a faulty motion task was started
n09	no reference point	not reference point set at start of motion task
n10*	PSTOP	PSTOP limit-switch activated
n11*	NSTOP	NSTOP limit-switch activated
n12	motor default values loaded	Only sine encoders with ENDAT or HIPERFACE format. Motor number stored in encoder memory different from number stored in drive memory, default parameters loaded
n13*	expansion card	expansion card not functioning correctly
n14	SinCos feedback	Sine encoder “wake & shake mode” , ends if drive is enabled and wake & shake is done.
n15	Table error	Velocity current table INXMODE 35 error
n16-n31	reserved	reserved
n32	Firmware beta version	The firmware is an unreleased beta version
A	Reset	RESET is active at DIGITAL IN x

* = These warning messages lead to a controlled shut-down of the drive (braking with the emergency ramp)

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V Extensions / Accessories

V.1 Expansion card -I/O-14/08-

This chapter describes the I/O-expansion card -I/O-14/08-. It only describes the additional features that the expansion card makes available for the SERVOSTAR 640/670.

If you ordered the expansion card together with the servo amplifier, then it will be delivered already inserted into the expansion slot of the servo amplifier and screwed fast.

The -I/O-14/08- provides you with 14 additional digital inputs and 8 digital outputs. The functions of the inputs and outputs are fixed. They are used to initiate the motion tasks that are stored in the servo amplifier and to evaluate signals from the integrated position control in the higher-level control.

The functions of the inputs and signal outputs correspond exactly to the functions that can be assigned to the digital-I/O on connector X3 of the SERVOSTAR 640/670.

The 24VDC supply for the expansion card is taken from the controller. All inputs and outputs are electrically isolated from the servo amplifier by optocoupler.

V.1.1 Fitting the expansion card

If you want to retrofit the I/O expansion card into a SERVOSTAR 640/670, proceed as follows:

- Use a suitable screwdriver to remove the cover of the option slot.
- Take care that no small items (such as screws) fall into the open option slot.
- Push the expansion card carefully into the guide rails that are provided, without twisting it.
- Press the expansion card firmly into the slot, until the front cover touches the fixing lugs. This ensures that the connectors make good contact.
- Screw the screws on the front cover into the threads in the fixing lugs.

V.1.2 Technical data

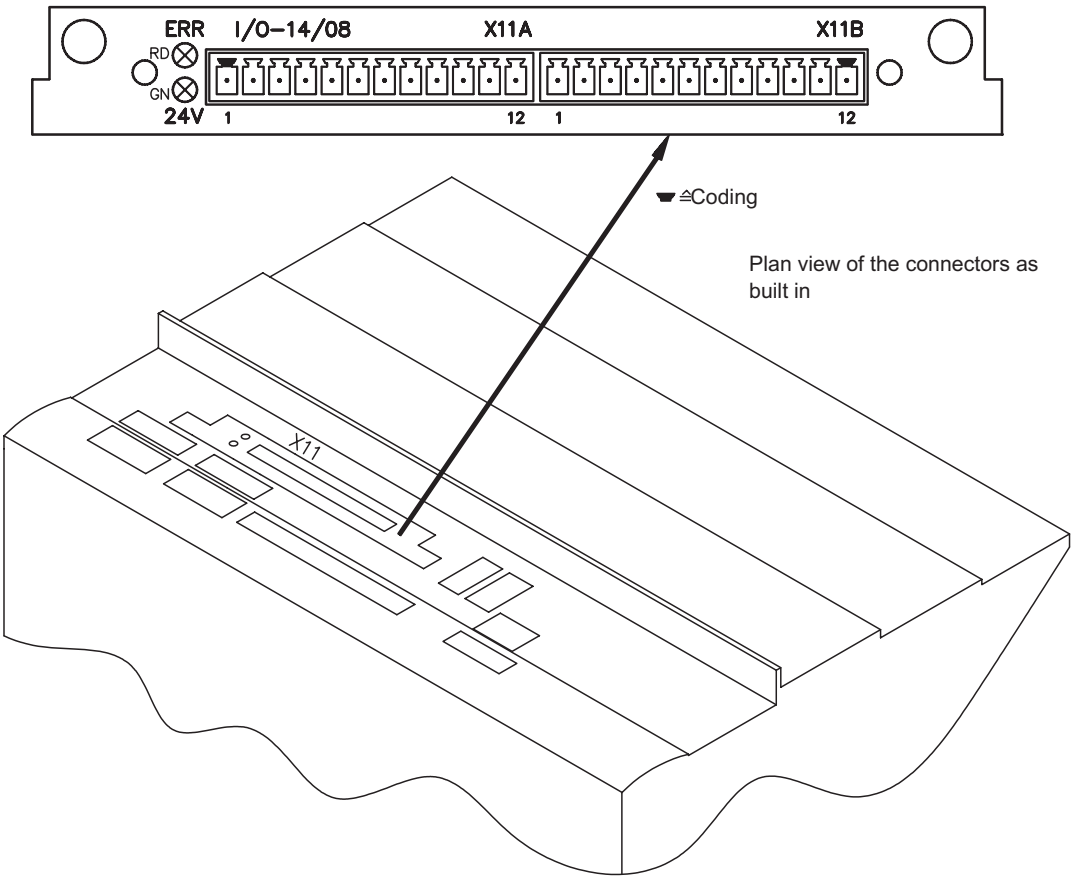
Control inputs	24V / 7mA, PLC-compatible
Signal outputs	24V / max. 500mA, PLC-compatible
Supply inputs, to IEC 1131	24V (18 ... 36V) / 100mA plus total current of the outputs (depends on the input wiring of the controls)
Fusing (external)	4 AT
Connectors	MiniCombicon, 12-pole, coded on PIN1 and 12 respectively
Cables	Data – up to 50m long : 22 x 0.5mm², unshielded, Supply – 2 x 1mm², check voltage drop
Waiting time between 2 motion tasks	depends on the response time of the control system
Addressing time (min.)	4ms
Starting delay (max.)	2ms
Response time of digital outputs	max. 10ms

The 24VDC voltage has to be supplied by an electrically isolated power supply, e.g. with insulating transformer.

V.1.3 Light emitting diodes (LEDs)

Two LEDs are mounted next to the terminals on the expansion card. The green LED signals that the 24V auxiliary supply is available for the expansion card. The red LED signals faults in the outputs from the expansion card (overload, short-circuit).

V.1.4 Position of the connectors



V.1.5 Connector assignments

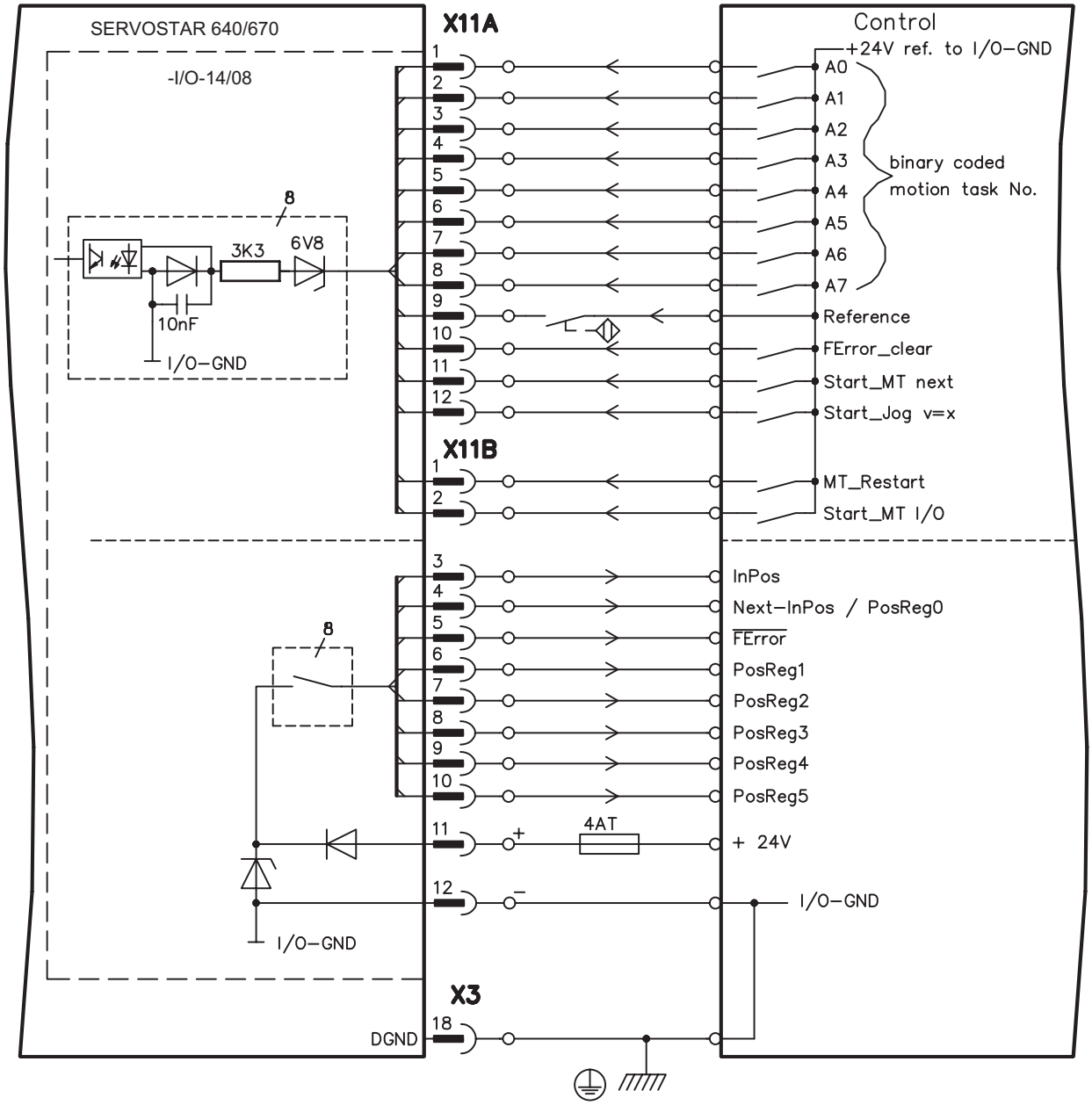
Connector X11A			
Terminal	**Function**	**Description**	
1	In	A0	Motion task no., LSB
2	In	A1	Motion task no., 2^1
3	In	A2	Motion task no., 2^2
4	In	A3	Motion task no., 2^3
5	In	A4	Motion task no., 2^4
6	In	A5	Motion task no., 2^5
7	In	A6	Motion task no., 2^6
8	In	A7	Motion task no., MSB
9	In	Reference	Polls the reference switch. If a digital input on the basic unit is used as a reference input, then the input on the I/O expansion card will **not** be evaluated.
10	In	FError_clear	Clear the warning of a following error or the response monitoring.
11	In	Start_MT Next	The following task, that is defined in the motion task by “Start with I/O” is started. The target position of the present motion task must be reached before the following task can be started. The next motion block can also be started by an appropriately configured digital input on the basic unit.
12	In	Start_Jog v=x	Start of the setup mode "Jog Mode" with a defined speed. After selecting the function, you can enter the speed in the auxiliary variable “x”. The sign of the auxiliary variable defines the direction. A rising edge starts the motion, a falling edge cancels the motion.

Connector X11B			
Terminal	**Function**	**Description**	
1	In	MT_Restart	Continues the motion task that was previously interrupted. The motion task can also be continued by an appropriately configured digital input on the basic unit.
2	In	Start_MT I/O	Start of the motion task that has the number that is presented, bit-coded, at the digital inputs (A0 to A7). The digital function with the same name, in the basic unit, starts the motion task with the address from the digital inputs on the basic unit.
3	Out	InPos	When the target position for a motion task has been reached (the InPosition window), this is signalled by the output of a HIGH-signal. **A cable break will not be detected**
4	Out	Next-InPos	The start of each motion task in an automatically executed sequence of motion tasks is signalled by an inversion of the output signal. The output produces a Low signal at the start of the first motion task of the motion task sequence. The form of the message can be varied by using ASCII commands.
		PosReg0	Can only be adjusted by ASCII commands.
5	Out	FError	Contouring-error (low-active).
6	Out	PosReg1	The preset function of the corresponding position register is indicated by a HIGH-signal.
7	Out	PosReg2	
8	Out	PosReg3	
9	Out	PosReg4	
10	Out	PosReg5	Can only be adjusted by ASCII commands.
11	Supply	24VDC	auxiliary supply voltage
12	Supply	I/O-GND	Digital-GND for the controls

V.1.6 Select motion task number (Sample)

Motion task no. (decimal	Motion task no. (binary) A7	A6	A5	A4	A3	A2	A1	A0
174	1	0	1	0	1	1	1	0

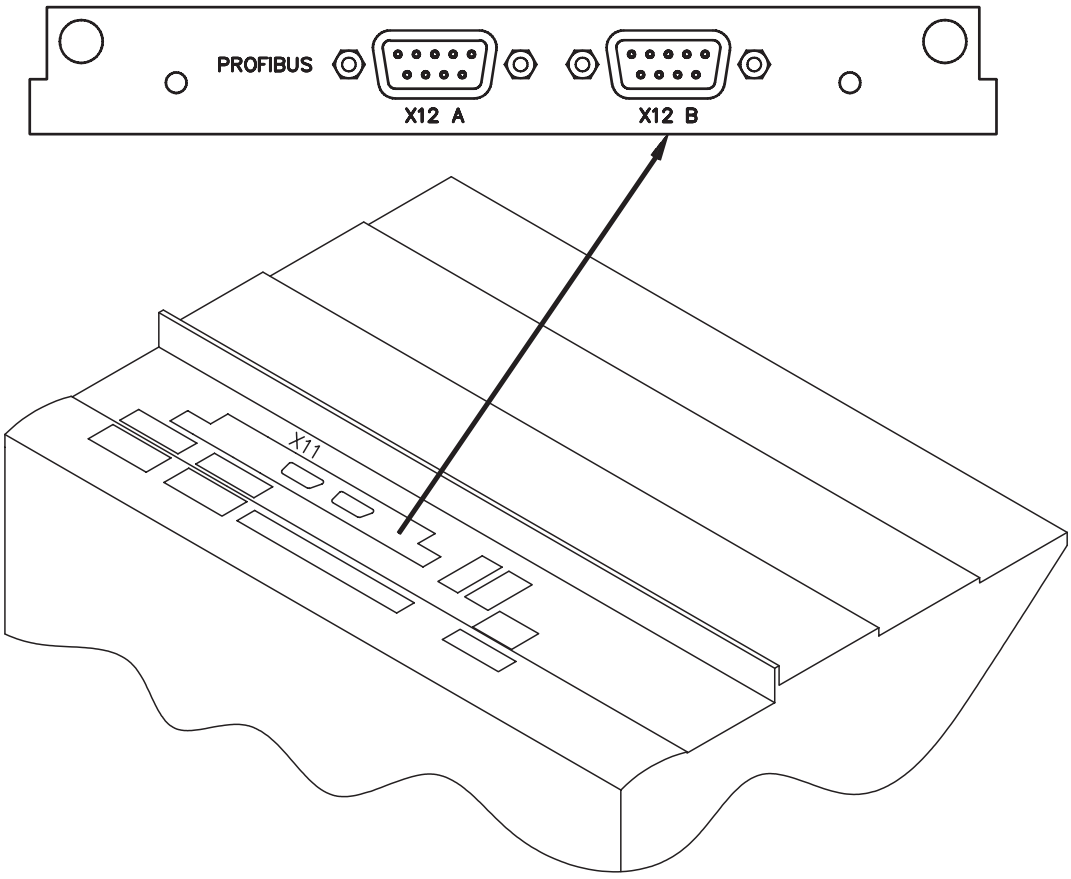
V.1.7 Connection diagram



V.2 Expansion card -PROFIBUS-

This chapter describes the PROFIBUS expansion card for the SERVOSTAR 640/670.
Information on the range of functions and the software protocol can be found in the manual "Communication profile PROFIBUS DP".
If you ordered the expansion card together with the servo amplifier, then the expansion card is already fitted and screwed into the slot when the servo amplifier is delivered.
The PROFIBUS expansion card has two 9-pin Sub-D sockets wired in parallel.
The supply voltage for the expansion card is provided by the servo amplifier.

V.2.1 Position of the connectors



V.2.2 Fitting the expansion card

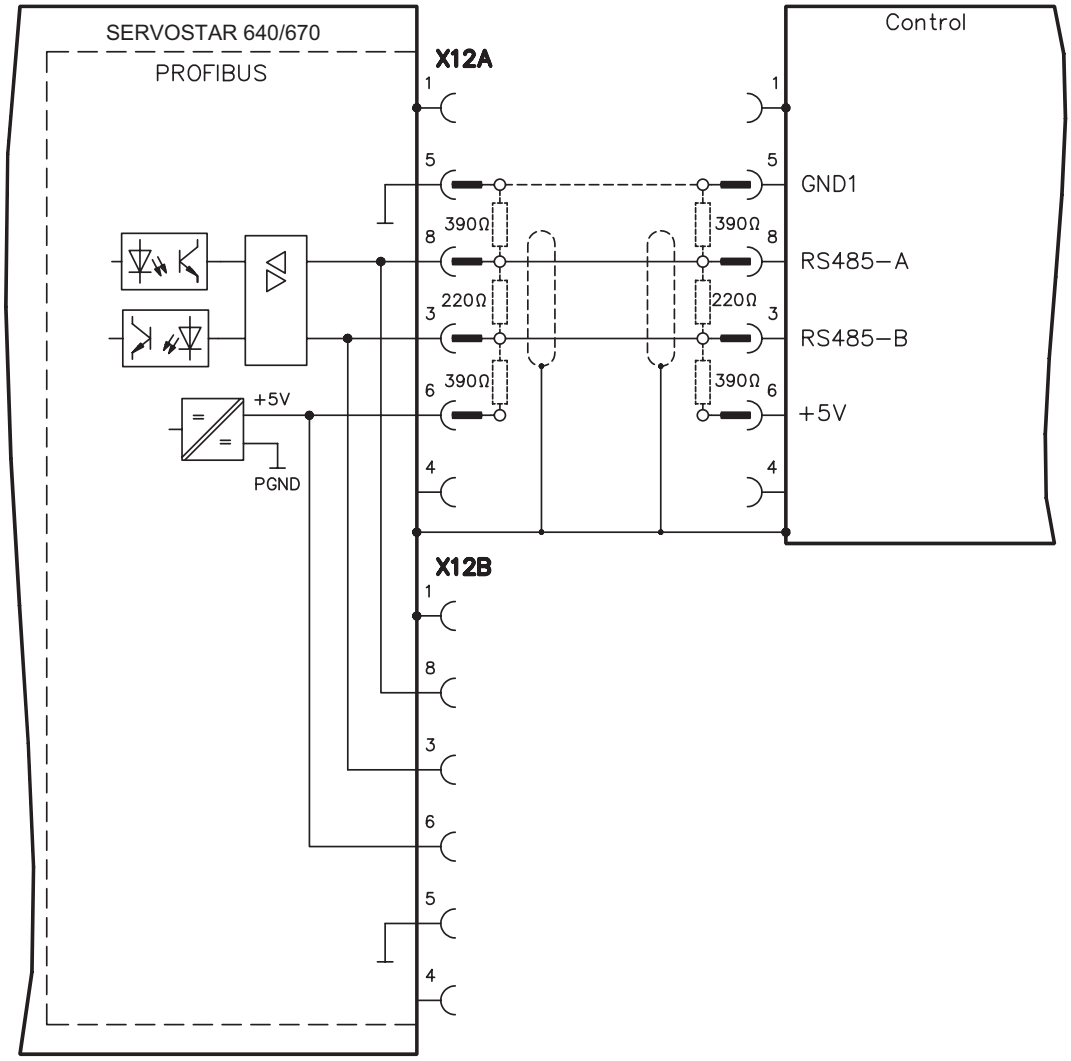
If you want to retrofit the PROFIBUS expansion card into a SERVOSTAR 640/670, proceed as follows:

- Use a suitable screwdriver to remove the cover of the option slot.
- Take care that no small items (such as screws) fall into the open option slot.
- Push the expansion card carefully into the guide rails that are provided, without twisting it.
- Press the expansion card firmly into the slot, until the front cover touches the fixing lugs. This ensures that the connectors make good contact.
- Screw the screws on the front cover into the threads in the fixing lugs.

V.2.3 Connection technology

Cable selection, cable routing, shielding, bus connector, bus termination and transmission times are all described in the “Installation guidelines for PROFIBUS-DP/”, Order No. 2.111, from PNO, the PROFIBUS User Organization.

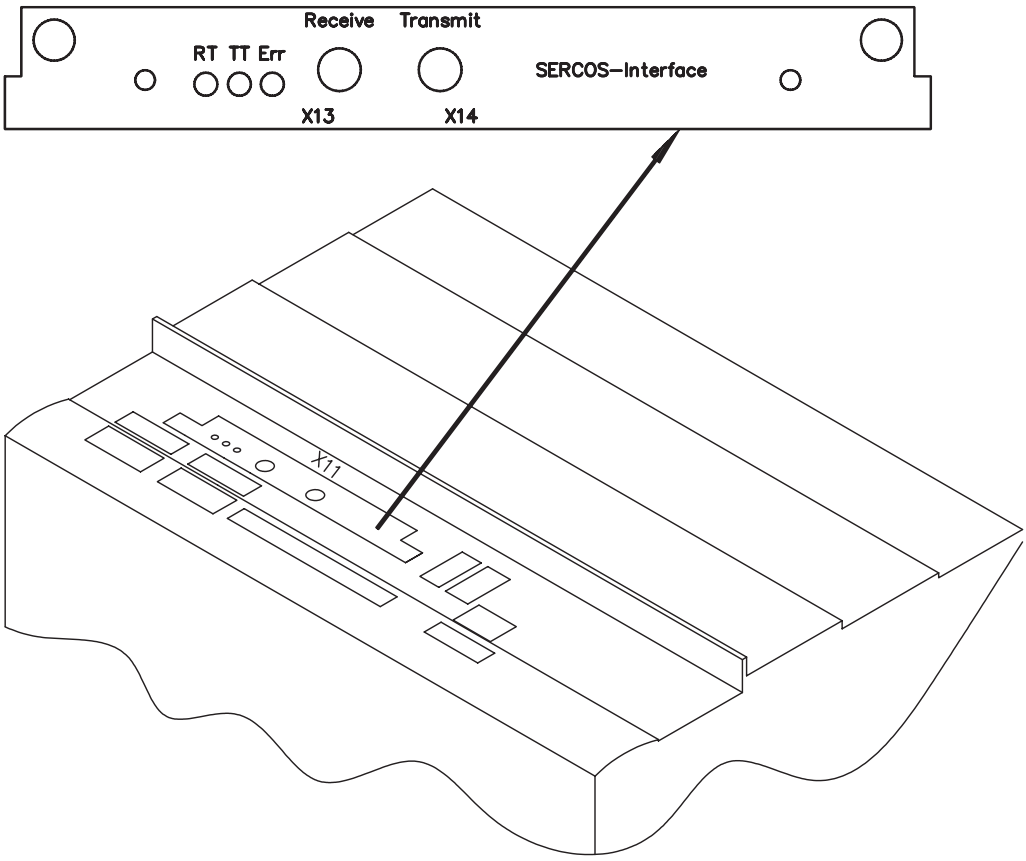
V.2.4 Connection diagram



V.3 Expansion card -SERCOS-

This chapter describes the SERCOS expansion card for SERVOSTAR 640/670.
Information on the range of functions and the software protocol can be found in the manual "IDN Reference Guide SERCOS".
If you ordered the expansion card together with the servo amplifier, then the expansion card is already fitted and screwed into the slot when the servo amplifier is delivered.

V.3.1 Position of the connectors



V.3.2 Fitting the expansion card

The expansion card can be retrofitted from firmware version 4.30. Proceed as follows:

- Use a suitable screwdriver to remove the cover of the option slot.
- Take care that no small items (such as screws) fall into the open option slot.
- Push the expansion card carefully into the guide rails that are provided, without twisting it.
- Press the expansion card firmly into the slot, until the front cover touches the fixing lugs. This ensures that the connectors make good contact.
- Screw the screws on the front cover into the threads in the fixing lugs.

V.3.3 Light emitting diodes (LEDs)

RT: indicates whether SERCOS telegrams are being correctly received. In the final Communication Phase 4 this LED should flicker, since cyclical telegrams are being received.

TT: indicates that SERCOS telegrams are being transmitted.
In the final Communication Phase 4 this LED should flicker,
since cyclical telegrams are being transmitted.
Check the stations addresses for the controls and the servo amplifier if:
- the LED never lights up in SERCOS Phase 1 or
- the axis cannot be operated, although the RT LED is lighting up cyclically.

Err : indicates that SERCOS communication is faulty or suffering from interference.
If this LED is very bright, then communication is suffering strong interference,
or is non-existent.
Check the SERCOS transmission speed for the controls and the servo amplifier (BAUDRATE) and the fibre-optic connection.
If this LED flickers, this indicates a low level of interference for Sercos communication,
or the optical transmitting power is not correctly adjusted to suit the length of cable.
Check the transmitting power of the (physically) previous SERCOS station.
The transmitting power of the servo amplifier can be adjusted in the setup software DRIVE.EXE on the SERCOS screen page, by altering the LWL length parameter for the cable length.

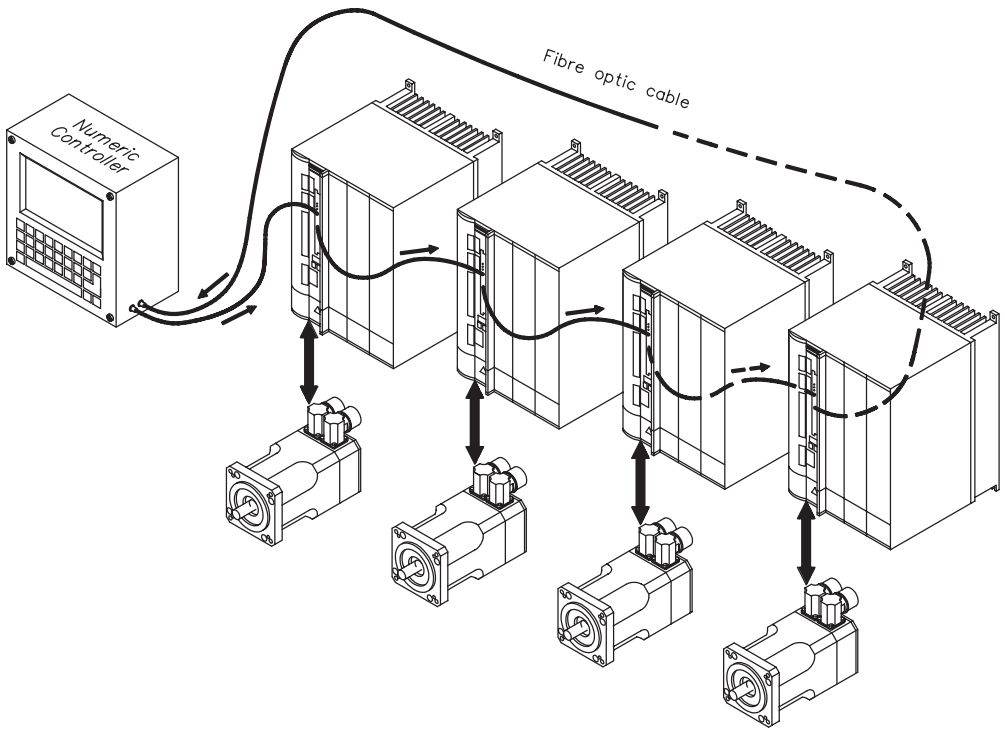
V.3.4 Connection technology

For the optical fibre (LWL) connection, only use SERCOS components to the SERCOS Standard IEC 61491.

Receive data:	The optical fibre carrying receive data for the drive in the ring structure is connected to X13 with an FSMA connector.
Transmit data:	Connect the optical fibre for the data output to X14 with an FSMA connector.

V.3.5 Connection diagram

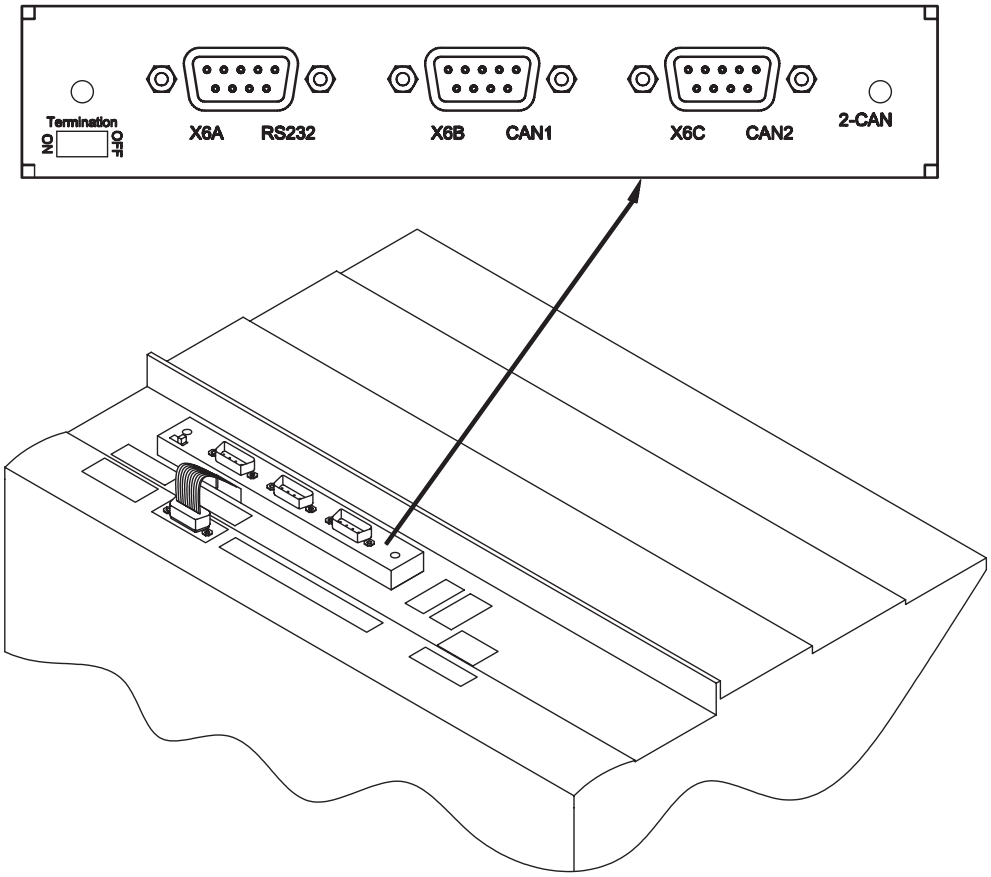
Layout of the SERCOS bus system in ring topology, with optical fibre cables (schematic).



V.4 Expansion module -2CAN-

Connector X6 of the SERVOSTAR is assigned to the signals for the RS232 interface and the CAN interface. It is therefore not the standard pin assignment for these interfaces, and a special cable is required to be able to use both interfaces simultaneously.
The -2CAN- expansion module provides the interfaces on separate Sub-D connectors. The two CAN connectors are wired in parallel. A termination resistor (120 Ω) for the CAN bus can be switched into circuit if the SERVOSTAR is at the end of the bus.

V.4.1 Position of the connectors



V.4.2 Fitting the expansion module

If you want to retrofit the -2CAN- expansion module into a SERVOSTAR, proceed as follows:

- Use a suitable screwdriver to remove the cover of the option slot.
- Take care that no small items (such as screws) fall into the open option slot.
- Screw the distance pieces into the fixing lugs of the option slot.
- Place the expansion module onto the option slot.
- Screw the screws into the threads of the distance pieces.
- Plug the Sub-D9 socket into connector X6 on the SERVOSTAR

V.4.3 Connection technology

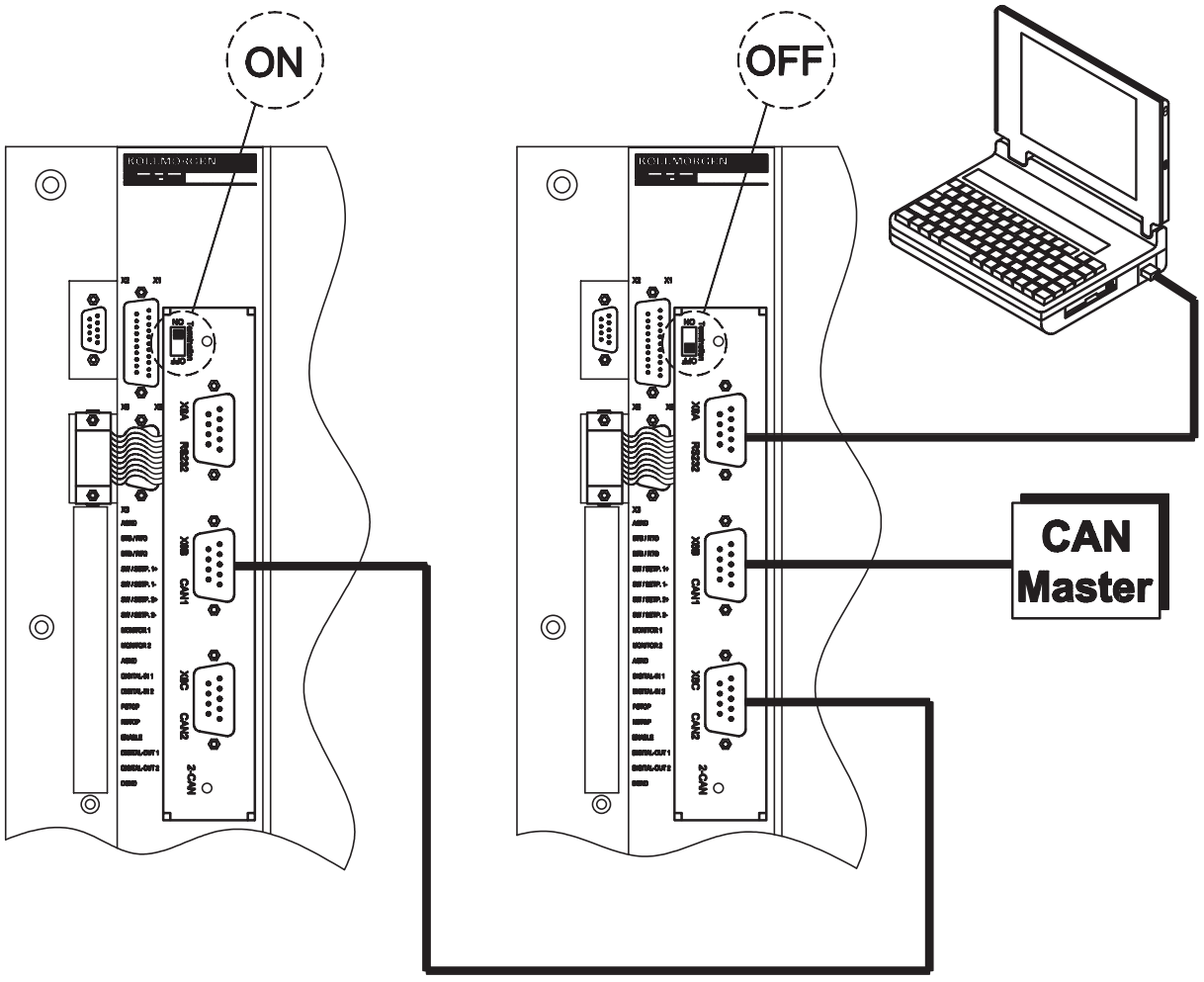
Standard shielded cables can be used for the RS232 and CAN interfaces.

If the servo amplifier is the last device on the CAN bus, then the switch for the bus termination must be set to ON.
Otherwise, the switch must be set to OFF (condition as delivered).

V.4.4 Connector assignments

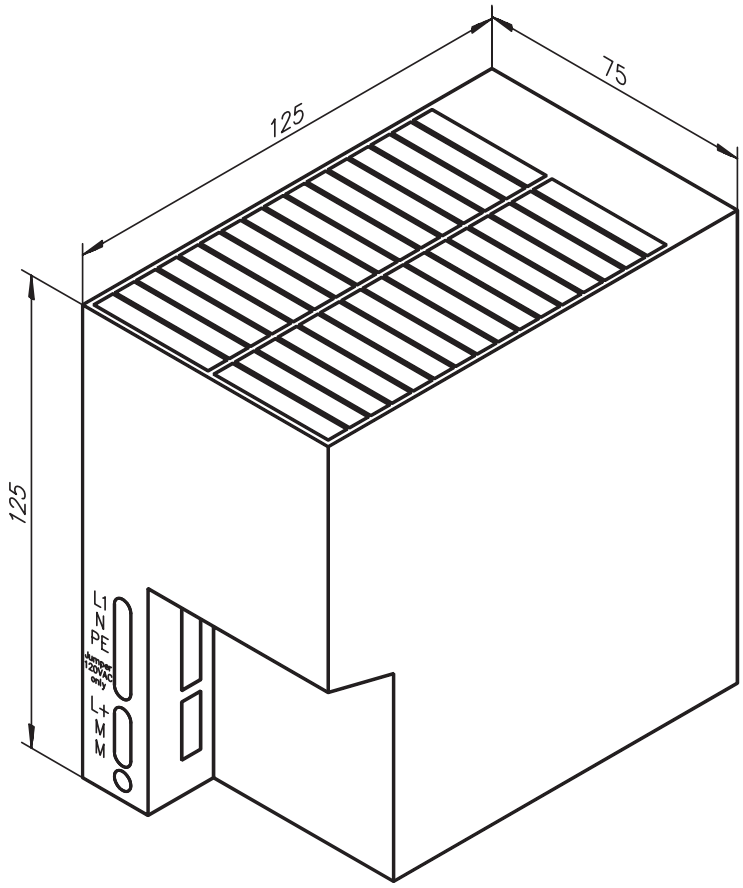
RS232		CAN1=CAN2	
X6A Pin	Signal	X6B=X6C Pin	Signal
1	Vcc	1	
2	RxD	2	CAN-Low
3	TxD	3	CAN-GND
4		4	
5	GND	5	
6		6	
7		7	CAN-High
8		8	
9		9	

V.4.5 Connection diagram



V.5 Accessories

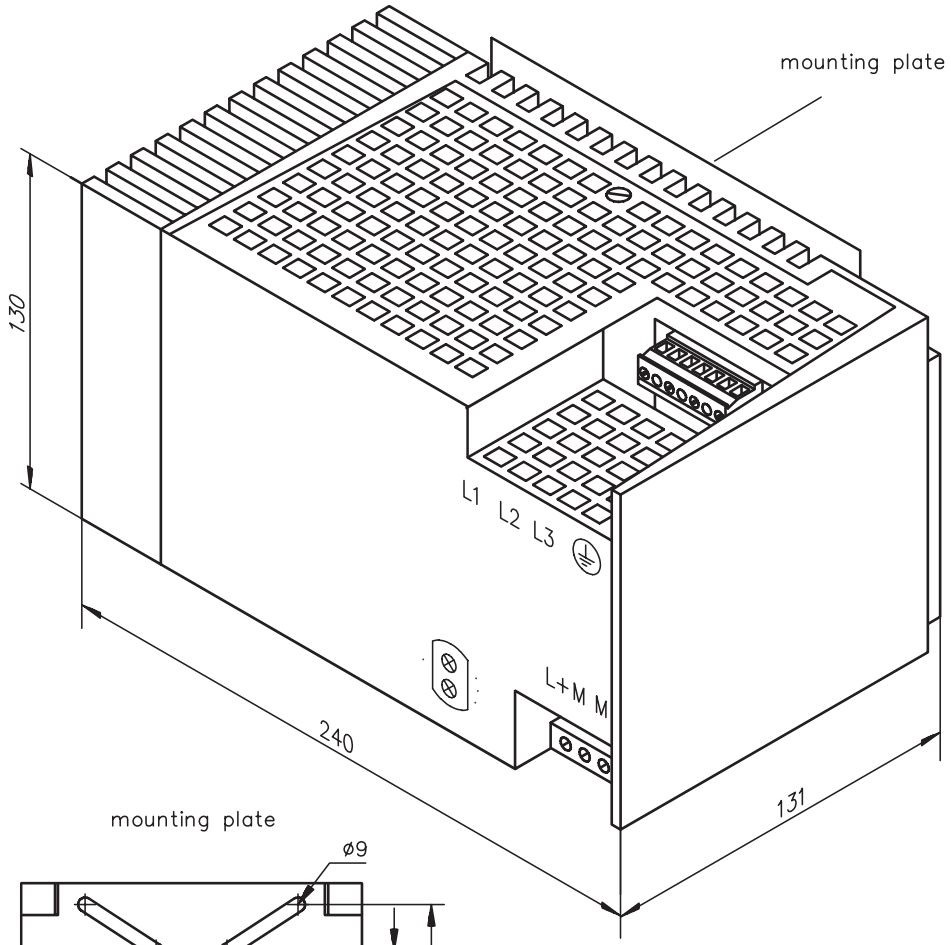
V.5.1 External 24VDC / 5A supply

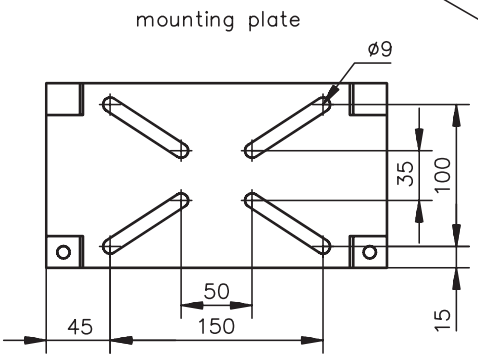


Technical data	
Input voltage	120 / 230V
Input current	0,9 / 0,6A
Frequency	50/60Hz
Primary fuse	3,15AT
Output voltage	24V ± 1%
Max. output current	5A
Residual ripple	<150mVss
Switching peaks	<240mVss
Output fuse	short circuit proof
Temperature range	0...+60°C
Type of mounting	DIN-rails, vertical mounting **Keep a clear space of 50mm above and below the instrument**
Weight	0,75kg

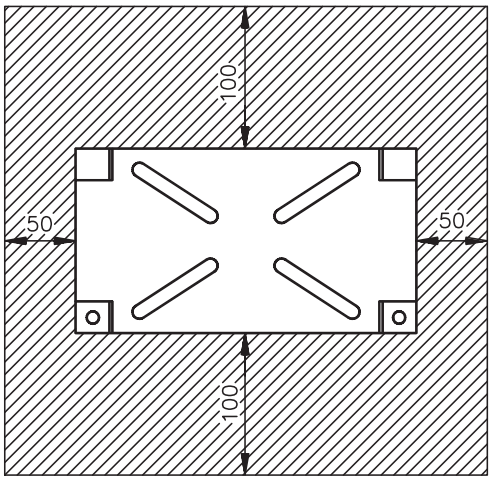
V.5.2 External 24VDC / 20A supply

24V DC / 20A



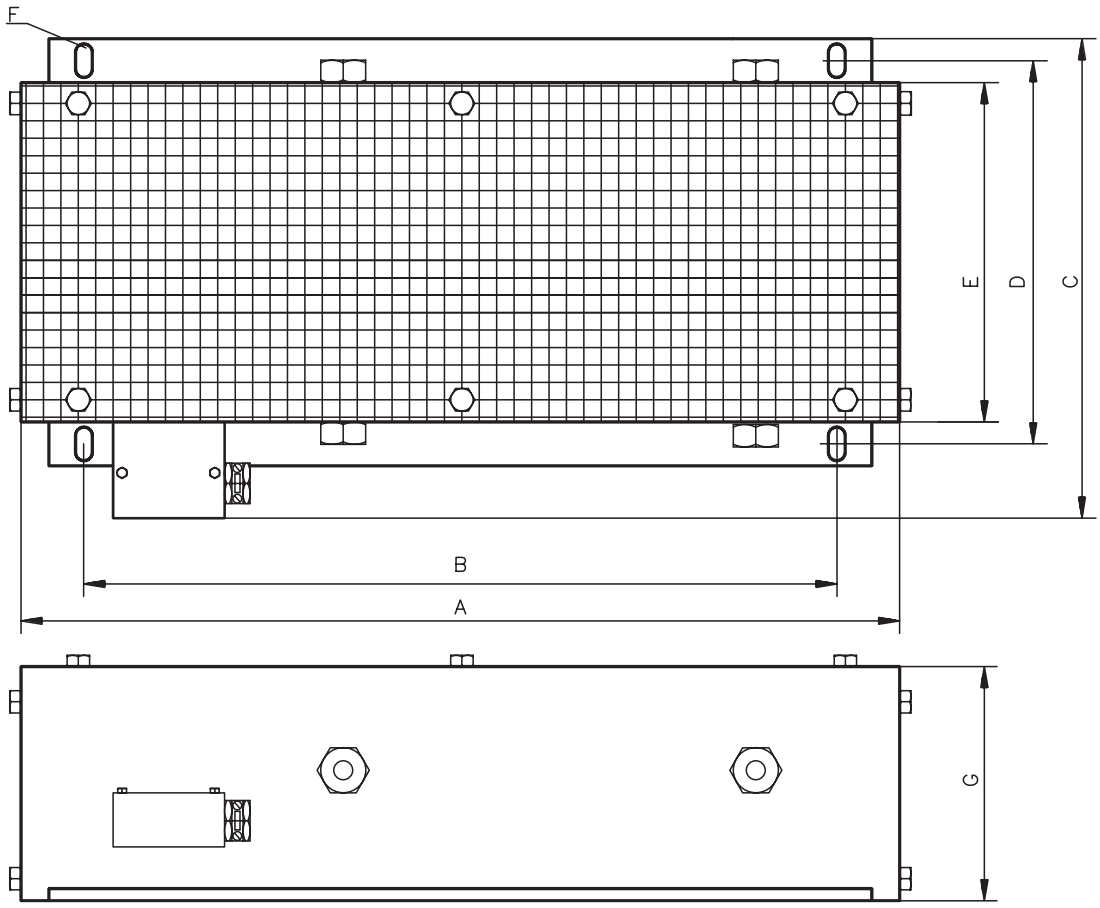


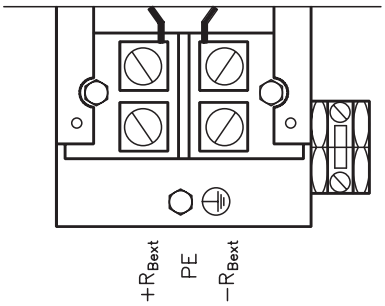
Technical data	
Input voltage	3 x 400VAC ± 10%
Input current	ca. 1,1A
Frequency	50/60Hz
Primary fuse	none
Output voltage	24V ± 1%
Max. output current	20A
Residual ripple	<0,1%
Output fuse	short circuit proof
Test voltage	acc. to VDE 0550
Temperature range	-20...+60°C (-4...140°F)
Type of mounting	on the supplied mounting plate **Keep the required space clear**
Weight	3,5kg



Keep space free

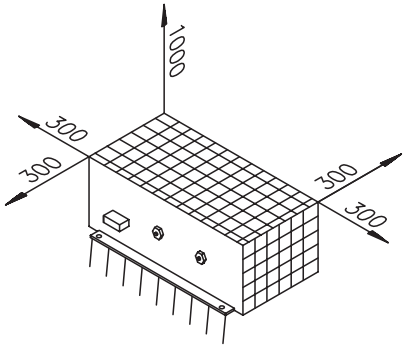
V.5.3 External regen resistor BAS



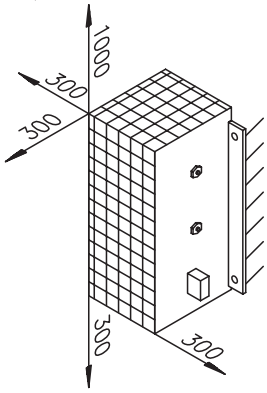


	R	Rated power	A	B	C	D	E	F	G	weight
	Ω	W	mm	mm	mm	mm	mm	mm	mm	Kg
BAS 2000–15	15	2000	490	380	230	175	150	ø10,5x13	260	6,0
BAS 3000–15	15	3000	490	380	330	270	250	ø10,5x13	260	9,5
BAS 6000–15	15	6000	490	380	430	370	350	ø10,5x13	260	13,0
BAS 2000–10	10	2000	490	380	230	175	150	ø10,5x13	260	6,0
BAS 3000–10	10	3000	490	380	330	270	250	ø10,5x13	260	9,5
BAS 6000–10	10	6000	490	380	430	370	350	ø10,5x13	260	13,0

Admissible floor mounting



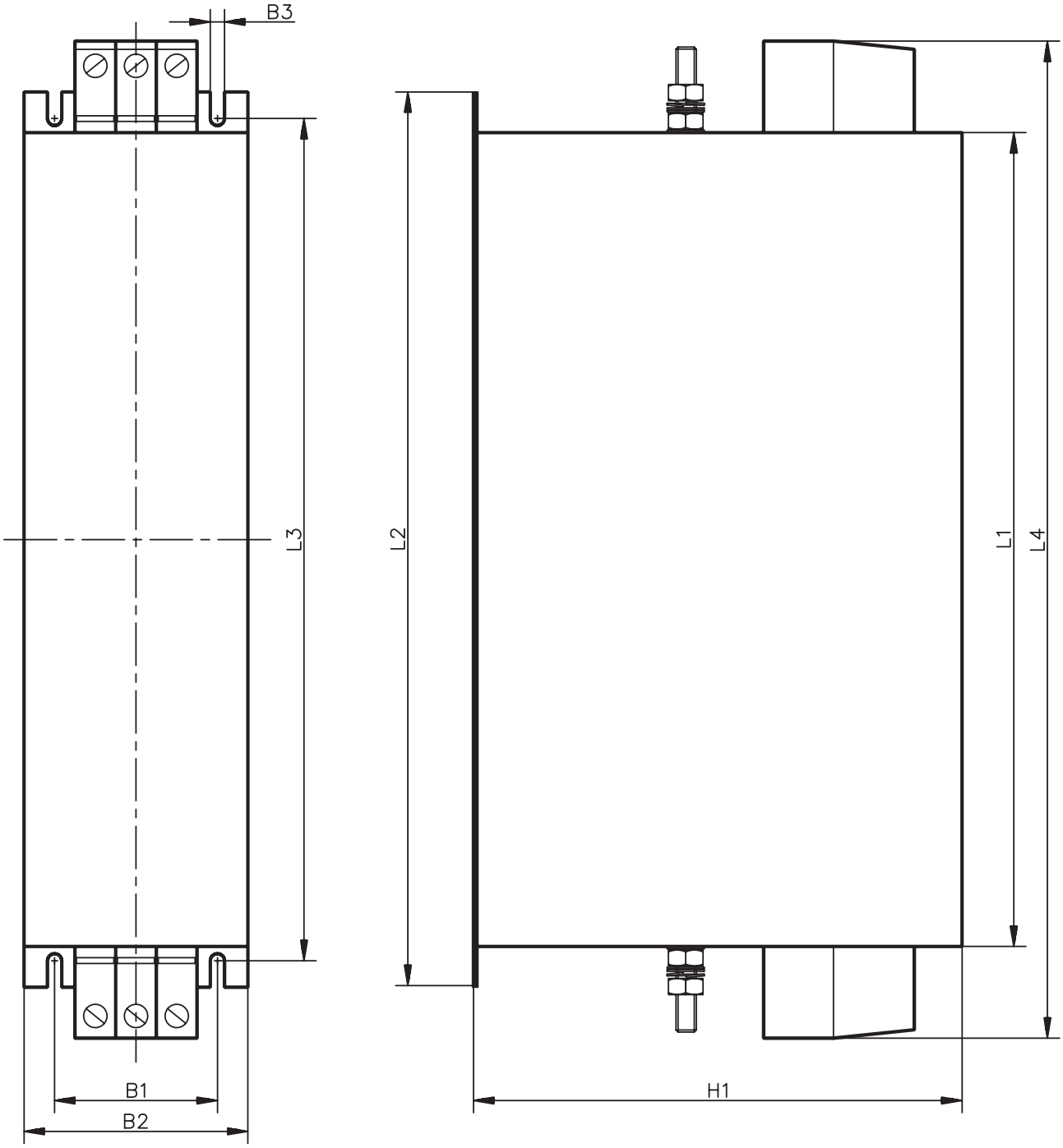
Admissible wall mounting
Clamps down



Other types of mounting are not admitted !

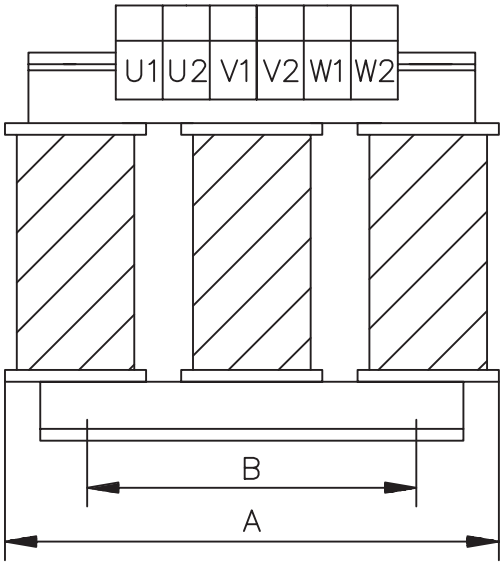
Caution:
Surface temperature may exceed 200°C.
Observe the requested free space.
Do not mount to combustible surface.

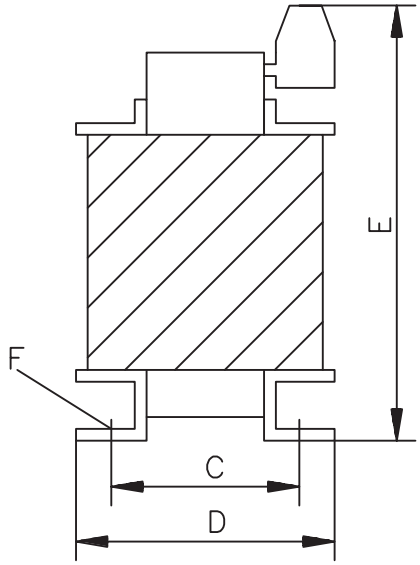
V.5.4 Mains filters



	Nom. current	L1	L2	L3	L4	B1	B2	B3	H1	Terminals	Bolts
Type	A	mm	mm	mm	mm	mm	mm	mm	mm	mm^2	mm
3EF−42	42	305	335	320	355	35	60	7	150	10	5
3EF−75	75	300	330	314	380	55	80	7	185	25	6
3EF−100	100	300	330	314	380	55	80	7	220	25	8
3EF−130	130	350	380	364	440	65	90	7	220	50	10

V.5.5 Mains chokes





Type		Dimensions in mm						Weight	Current
	Phase	A	B	C	D	E	F	kg	A
3L 0,5–60	3	190	170	58	110	255	ø8	9	60
3L 0,4–75	3	190	170	68	120	255	ø8	10	75
3L 0,3–100	3	210	180	71	120	275	ø8	12	100
3L 0,2–130	3	240	190	96	150	300	ø11	18	130

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VI Appendix

VI.1 Transport, storage, maintenance, disposal

Transport :
— only by qualified personnel
— only in the manufacturer's original recyclable packaging
— avoid shocks
— temperature –25 to +70°C (-13...158°F), max. 20k/hr rate of change
— humidity max. 95% relative humidity, no condensation
— the servo amplifiers contain electrostatically sensitive components which can be damaged by incorrect handling
Discharge yourself before touching the servo amplifier. Avoid contact with highly insulating materials (artificial fabrics, plastic films etc.).
Place the servo amplifier on a conductive surface.
— if the packaging is damaged, check the unit for visible damage.
In this case, inform the shipper and the manufacturer.

Packaging:
— Cardboard box with foam padding, can be recycled
— Dimensions: (HxWxD) 410x470x490 mm
— Gross weight, accessories included, approx. 25 Kg

Storage :
— only in the manufacturer's original recyclable packaging
— the servo amplifiers contain electrostatically sensitive components which can be damaged by incorrect handling
Discharge yourself before touching the servo amplifier. Avoid contact with highly insulating materials (artificial fabrics, plastic films etc.),
Place the servo amplifier on a conductive surface.
— max. stacking height for SERVOSTAR 640/670 : 3 cartons
— storage temperature –25 to +55°C(-13...131°F),
max. 20K/hr. rate of change
— humidity relative humidity max. 95%, no condensation
— storage duration < 1 year without restriction
> 1 year : capacitors must be **re-formed** before setting up the servo amplifier.
To do this, remove all electrical connections and supply the servo amplifier for about 30 min. From 230VAC, single-phase, on terminals L1 / L2.

Maintenance :
— the instruments do not require any maintenance
— opening the instruments invalidates the warranty

Cleaning :
— if the casing is dirty : cleaning with Isopropanol or similar
do not immerse or spray
— if there is dirt inside the unit : to be cleaned by the manufacturer
— dirty protective grill (fan) : clean with a dry brush

Disposal :
— the servo amplifier can be reduced to its principal components by unscrewing it (aluminium heat sink and front panel steel housing sections, electronics boards)
— disposal should be carried out by a certified disposal company.
We can give you suitable addresses.

VI.2 Removing faults/warnings

The table below should be regarded as a “First-aid” box. Depending on the conditions in your installation, there may be a wide variety of reasons for the fault. In multi-axis systems there may be further hidden causes of a fault. Our customer service can give you further assistance with problems.

Fault	possible causes	Measures to remove the cause of the fault
HMI message: communication fault	— wrong cable used — cable plugged into wrong position in servo amplifier or PC — wrong PC interface selected	— use null-modem cable — plug cable into the correct sockets on the servo amplifier and PC — select correct interface
F01 message: heat sink temperature	— permissible heat sink temperature exceeded	— improve ventilation
F02 message: overvoltage	— regen power is insufficient. regen power limit was reached and the regen resistor was switched off. This causes excessive voltage in the DC-link circuit. — supply voltage too high	— shorten the braking time RAMP or use an external regen resistor with a higher power rating and adjust the regen power parameter — use mains transformer
F04 message: feedback unit	— feedback connector not properly inserted — feedback cable is broken, crushed or otherwise damaged	— check connector — check cable
F05 message: undervoltage	— supply voltage not present or too low when servo amplifier is enabled	— only enable the servo amplifier when the mains supply voltage has been switched on delay > 500 ms
F06 message: motor temperature	— motor thermostat has been activated — feedback connector is loose or break in feedback cable	— wait until motor has cooled down, then check why it became so hot — tighten connector or use new feedback cable
F07 message: aux. voltage	— the aux. voltage produced by the servo amplifier is incorrect	— return the servo amplifier to the manufacturer for repair
F08 message: motor runs away (overspeed)	— motor phases swapped — feedback set up incorrectly	— correct motor phase sequence — set up correct offset angle
F11 message: brake	— short-circuit in the supply cable for the motor-holding brake — motor-holding brake is faulty — fault in brake cable — no brake connected, although the brake parameter is set to "WITH"	— remove short-circuit — replace motor — check shielding of brake cable — brake parameter set to "WITHOUT"
F13 message: internal temperature	— permissible internal temperature exceeded	— improve ventilation
F14 message: output stage fault	— motor cable has short-circuit/ground short — motor has short-circuit / ground short — output module is overheated — output stage is faulty — short-circuit / short to ground in the external regen resistor	— replace cable — replace motor — improve ventilation — return the servo amplifier to the manufacturer for repair — remove short-circuit / ground short
F16 message: mains BTB/RTO	— enable was applied, although the supply voltage was not present. — at least 2 supply phases are missing	— only enable the servo amplifier when the mains supply voltage has been switched on — check electrical supply
F17 message: A/D converter	— error in the analog-digital conversion, usually caused by excessive EMI	— reduce EMI, check screening and grounding

Fault	possible causes	measures to remove the cause of the fault
F25 message: Commutation error	— wrong cable — wrong phasing	— check wiring — check resolver poles (RESPOLES) check motor poles (MPOLES) check offset (MPHASE)
F27 message: error AS-option	— -AS-24V relay AND hardware enable AND software enable are active	— check PLC programming and wiring
motor does not rotate	— servo amplifier not enabled — break in setpoint cable — motor phases swapped — brake not released — drive is mechanically blocked — no. of motor poles set incorrectly — feedback set up incorrectly	— apply enable signal — check setpoint cable — correct motor phase sequence — check brake control — check mechanism — set no. of motor poles — set up feedback correctly
motor oscillates	— gain too high (speed controller) — shielding in feedback cable has a break — AGND not wired up	— reduce Kp (speed controller) — replace feedback cable — join AGND to CNC-GND
drive reports following error	— I_{rms} or I_{peak} is set to low — setpoint ramp is too long	— increase I_{rms} or I_{peak} (keep within motor data !) — shorten setpoint ramp +/-
motor overheating	— I_{rms}/I_{peak} set too high	— reduce I_{rms}/I_{peak}
drive too soft	— Kp (speed controller) too low — Tn (speed controller) too high — PID-T2 too high — T-Tacho too high	— increase Kp (speed controller) — use motor default value for Tn (speed controller) — reduce PID-T2 — reduce T-Tacho
drive runs roughly	— Kp (speed controller) too high — Tn (speed controller) too low — PID-T2 too low — T-Tacho too low	— reduce Kp (speed controller) — use motor default value for Tn (speed controller) — increase PID-T2 — increase T-Tacho
axis drifts at setpoint = 0V	— offset not correctly adjusted for analog setpoint provision — AGND not joined to the CNC-GND of the controls	— adjust setpoint-offset (analog I/O) — join AGND and CNC-GND
n12 message: Motor default values loaded	— Motor number stored in sine encoders EEPROM different than what drive is configured for	— If n12 is displayed, default values for the motor are loaded. Motor number will be automatically stored in EEPROM with SAVE.
n14 message: Wake & shake active	— Wake & shake not executed	— Enable the drive

VI.3 Glossary

C	Clock	Clock signal
	Common-mode voltage	The maximum amplitude of a disturbance (on both inputs) which a differential input can eliminate
	CONNECT- modules	Modules built into the servo amplifier, with integrated position control, which provide special versions of the interface for the connection to the higher-level control
	Continuous power of regen circuit	Mean power which can be dissipated in the regen circuit
	Counts	Internal count pulses, 1 pulse = $1/2^{20}$ $turn^{-1}$
	Current controller	Regulates the difference between the current setpoint and the actual value to 0 Output : power output voltage
D	DC-link	Rectified and smoothed power voltage
	Disable	Removal of the enable signal (0V or open)
E	Enable	Enable signal for the servo amplifier (+24V)
F	Final speed	Maximum value for speed normalization at ±10V
	Fieldbus interface	CANopen, PROFIBUS, SERCOS
G	GRAY-code	Special method of representing binary numbers
H	Holding brake	Brake in the motor, which can only be used when the motor is at stillstand
I	I²t threshold	Monitoring of the actually required r.m.s. current
	Input drift	Temperature and age-dependent alteration of an analog input
	Incremental encoder interface	Position signalling by 2 signals with 90° phase difference, not an absolute position output
	Ipeak, peak current	The effective value of the peak current
	Irms, effective current	The r.m.s. value of the continuous current
K	Kp, P-gain	Proportional gain of a control loop
L	Limit-switch	Switch limiting the traverse path of the machine; implemented as n.c. (break) contact
M	Machine	The complete assembly of all connected parts or devices, of which at least one is movable
	Monitor output	Output of an analog measurement
	Motion-block	Data packet with all the position control parameters which are required for a motion task
	Multi-axis system	Machine with several independently driven axes
N	Natural convection	Free movement of air for cooling
O	Optocoupler	Optical connection between two electrically independent systems

P	P-controller	Control loop with purely proportional behavior
	Phase shift	Compensation for the lag between the electromagnetic and magnetic fields in the motor
	PID-controller	Control loop with proportional, integral and differential behavior
	PID-T2	Filter time constant for the speed controller output
	Position controller	Regulates the difference between the position setpoint and the actual position to 0 Output : speed setpoint
	Potential isolation	Electrically decoupled
	Power contactor	System protection device with phase monitoring
	Pulse power of the regen circuit	Maximum power which can be dissipated in the regen circuit
R	Regen circuit	Converts superfluous energy, which is fed back during braking, into heat in the regen resistor
	Reset	New start of the microprocessor
	Resolver-digital converter	Conversion of the analog resolver signals into digital information
	Reversing mode	Operation with a periodic change of direction
	Ring core	Ferrite rings for interference suppression
	ROD-Interface	Incremental position output
S	Servo amplifier	Control device for regulating the position of a servomotor
	Setpoint ramps	Limits for the rate of change of the speed setpoint
	Short to ground	Electrically conductive connection between a phase and PE (protective earth)
	Short-circuit	here: electrically conductive connection between two phases
	Speed controller	Regulates the difference between the speed setpoint and the actual value to 0 Output : current setpoint
	SSI-interface	Cyclic-absolute, serial position output
	Supply filter	Device to divert interference on the power supply cables to PE
T	T-tacho, tachometer time constant	Filter time constant in the speed feedback of the control loop
	Tachometer voltage	Voltage proportional to the actual speed
	Thermostat	Temperature-sensitive switch built into the motor winding
	Tn, I-integration time	Integral section of a control loop
Z	Zero pulse	Output once per turn from incremental encoders, used to zero the machine

VI.4 Order numbers

In the table below you'll find the order numbers for the servo amplifiers, options and accessories.

Type	European order number	North America order code
SERVOSTAR 640	91419	S64001-NA
SERVOSTAR 670	91955	S67001-NA
Expansion card PROFIBUS DP	90056	OPT-PB
Expansion card SERCOS	90879	OPT-SE
Expansion card -I/0-14/08-	90057	OPT-EI
Expansion module -2CAN-	101174	Not available in North America
Mains filter 3EF-42	92102	LF-42
Mains filter 3EF-75	92103	LF-75
Mains filter 3EF-100	92104	LF-100
Mains filter 3EF-130	92105	LF-130
Mains choke 3L0.5-60	95289	LC-60
Mains choke 3L0.4-75	92100	LC-75
Mains choke 3L0.3-100	92098	LC-100
Mains choke 3L0.2-130	92099	LC-130
RS232 cable	90067	A-97251-004
RS232 multilink cable -SR6Y-	90060	A-SR6Y
RS232 multilink cable -SR6Y6-	92042	Not available in North America
Power supply 24V/5A	83034	Not available in North America
Power supply 24V/20A	81279	Not available in North America
Regen resistor BAS 2000-15	103871	BAS-2000-15
Regen resistor BAS 3000-15	103872	BAS-3000-15
Regen resistor BAS 6000-15	103873	BAS-6000-15
Regen resistor BAS 2000-10	103874	BAS-2000-10
Regen resistor BAS 3000-10	103875	BAS-3000-10
Regen resistor BAS 6000-10	103876	BAS-6000-10
Product CD-ROM	90079	KOL-1270

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E-Mail	**info@danaher-motion.de**
Phone.:	+49(0)203 - 99 79 - 0
Fax:	+49(0)203 - 99 79 - 155

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